



## ICS 4 Human Factors for the Web

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<http://www.ics.uci.edu/~kay/courses/4/slides.pdf>

### ICS 4 Overview

- **The field of HCI**
- Human characteristics
- User-centered design
- Content organization and navigation
- Evaluation strategies
- Building blocks (color, typography, ...)
- The broader context

### What is HCI?

- Narrowly: 1 user, 1 computer
  - Focus on software, layout and operation of UI
- Broadly: people and computers
  - Users' mental processes, work practices
  - Training; collaboration; management
  - Social/organizational/health issues

### Acknowledgements and caveat

These slides draw liberally from the Informatics 131 slides of Prof. Alfred Kobsa and the slides from our textbook, McCracken and Wolfe's *User-Centered Web Development*.

Caveat (beware): At best, PowerPoint slides are only a pale imitation of the entirety of a class meeting. In ICS 4 in particular, the lectures will cover topics beyond what appears in these slides. Don't rely on them as a substitute for attending class.

### Why are we here?

- The web is everywhere
- People time is more expensive than computer time
- Interfaces matter: for efficiency, for convenience, for commercial success, even for life and death
- Everyone has stories of bad user interfaces

### Six aspects of HCI

- Human abilities (perception, memory, ...)
- Technologies (browsers, links, cellphones, ...)
- Design methods (prototyping, lifecycles, ...)
- Evaluation methods (experiments, observation, ...)
- Guidelines and results (what has been proven to work in particular situations, e.g., typography)
- Implementation tools and techniques

## ICS 4 Recurring Themes

- People are diverse, unpredictable, messy, and ill-understood
- You (the designer) may not be qualified to know what the user needs
- You have to evaluate constantly, at every stage of development
- The later you are in the development cycle, the more it costs to make changes

## Administrative Stuff

- Syllabus
- Your “HCI Notebook”: Carry it with you always!

## Usability goals

- Satisfaction (utility, effectiveness, experience)
- Safety/robustness
- Efficiency (time, movement)
- Learnability
- Memorability

## How did the field of HCI arise?

- Once, it was enough if software just worked (most of the time)
- Once, the burden was on the user
- Today, you have to care: Success of a product (and well-being of users) depends on good UI

## How do we know a UI is good?

- Analyze using “common sense”
- Develop a theory of “human cognitive processing” to predict users’ problems
- Test the UI on actual users; problems arise
  - Generalize findings, develop guidelines for avoiding problems: Usability Engineering
- But how can we know it’s problem-free?

## Usability principles/heuristics (Jakob Nielsen)

- |                                       |   |
|---------------------------------------|---|
| • Visibility of system status         | • Recognition over recall                                 |
| • Match between system and real world | • Flexibility and efficiency of use                       |
| • User control and freedom            | • Aesthetic and minimalist design                         |
| • Consistency and standards           | • Help users recognize, diagnose, and recover from errors |
| • Error prevention                    | • Help and documentation                                  |

## Internet and web basics

- Organization of internet: no central point; packet switching
- Internet services (WWW, Email, IM, ...)
- Web: hypertext, HTML, HTTP, browser, URL, domains

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## Human perception and cognition

- If we're designing web sites for human users, it only makes sense to know something about "how people work"
- Our brains don't just "take pictures": They process, select, categorize, model

## Cognition

- Attention • •
- Perception/recognition
- Memory
- Learning
- Reading, speaking, listening
- Problem-solving, planning, reasoning, decision-making

## Gestalt principles

- Whole picture, perception in context
- Use these in designing to reinforce meaning, guide user
- Proximity •
- Similarity •
- Closure •
- Continuity • •
- Symmetry •

## Memory

- Sensory, pre-attentive
- Short-term
- Long-term (with practice, repetition)
- Recognition vs. recall
- Active vs. passive learning

## Pre-attentive processing

- Before you get to conscious attention
- Examples: length, width, size, number, closure, color, intensity, flashing, direction of motion • •

## Conceptual/mental models

- Model: abstraction, simplification
- How user thinks of system/device/product
- Functional (how it works, how to use)
  - Should match the task
- Structural (how it's organized, built)
  - Harder to acquire from experience
  - Useful for extension, integration
- May not match reality
  - Maybe that's okay

## Metaphors

- A package of elements
  - Analogy with real-world items
  - Draw on user's knowledge, experience
- Metaphors only go so far
- Typewriter, desktop, book, filing cabinet • •, office, library, building •, city •, agent •
- Skeuomorphism: design derived from a different medium

## Agents

- Another metaphor
- Abstract, animated, embodied/physical
- Credibility comes from
  - Agency: take action, deliver results
  - Responsiveness: infer goals, learn about user
  - Predictability on basis of character
  - Trustworthiness: consistent actions for character

## Affordances: giving a clue

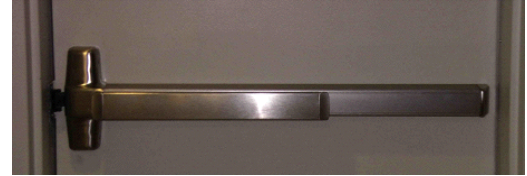
- What the user can see that an object does
- Chairs afford sitting; handles afford pulling
- By now, many users are used to on-screen conventions (affordances are just perceived)
  - Learned conventions
  - E.g., buttons and scrollbars—clear to novices?
  - Metaphors, e.g. play/pause button



Pull the handle. Does the door open?



Twist the handle; it doesn't turn. Is the room locked?



An affordance for pushing



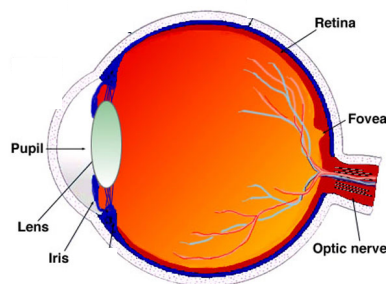
An espresso machine in a dentist's waiting room



The coffee capsule goes under the clear plastic part of the "bull's eye." How do you insert it?

## Human vision for color

- About 180° of arc
- Light reception happens in retina (back of eye)



## The retina

- Fovea (highest-resolution area)
  - Just 2° of arc
  - 75% of visual operations
- Not like a camera; doesn't take the whole picture at once •

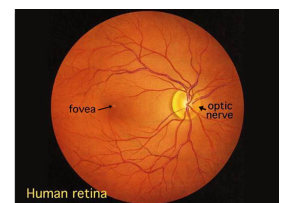
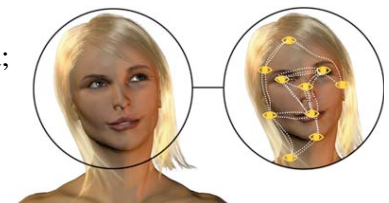
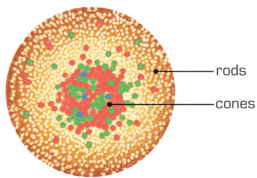
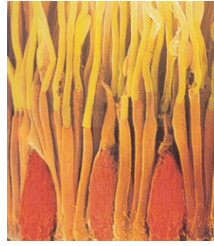


Fig. 1. Human retina as seen through an ophthalmoscope.





## Photo-receptors in retina



- Rods: Degrees of brightness; not in fovea
- Cones: Colors; in fovea mainly.
  - Red-sensitive (64%): many in fovea
  - Green-sensitive (32%): many in fovea
  - Blue-sensitive (2%): not in fovea; evenly distributed over retina

## Guidelines based on physiology

- Avoid blue for small objects
- Blue is good for background
- Neighboring objects should not differ just by amount of blue **a a a**
- Put small red and green objects in center
- Add other emphasis to red and green warning signals on the periphery
- Black, white, yellow, blue OK on periphery

## Graphical coding

We can use differences in  
color / shape / words / line width / size / ...  
to distinguish objects of the same type  
(icons, controls, data, lines in a graph ...)

What kinds of differences are most effective?

Table from Maguire (1987) •

## Menu selection time

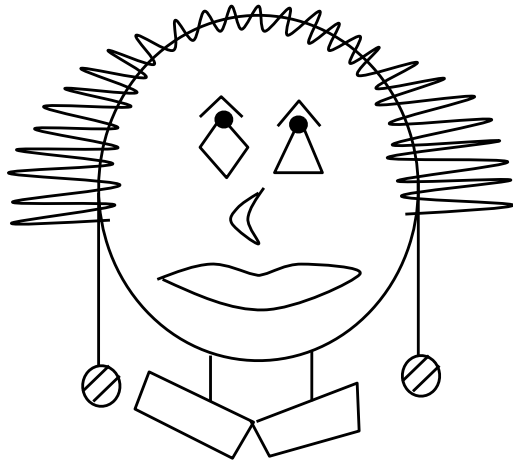
- Selection time = search time (“S”) +
  - if using keyboard, time to press key(s)
  - if using pointer, positioning time (“P”) + activation time (e.g., to click mouse)
- For beginners searching menu size  $n$ :
  - if label unknown, examine all items, so  $S \sim n$
  - if label known, search linearly or randomly; in either case,  $S \sim n$
- Experts can remember position; S is constant

## Menu positioning time (“P”)

- Fitts’ Law:  $P = C1 + C2(\log_2(2D/W))$ 
  - C1 and C2 are constants depending on device
  - D is distance to the center of the target
  - W is size (width) of the object (how much can you miss its center by?)
- The time to acquire a target is a function of the distance to and size of the target
- Screen edge: no chance to overshoot (size is effectively infinite)

## Learning modes (sensory input)

- Visual
- Auditory
- Kinesthetic
- Exercise from Sandra Sparling



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## HCI design

- Many roles (HCI designers, graphic designers/artists, tech writers, user reps, management reps, programmers)
- Determining users' needs, requirements
- Must precede coding/implementation
- Guidelines/standards to follow
- Evaluation throughout process

## User-centered design

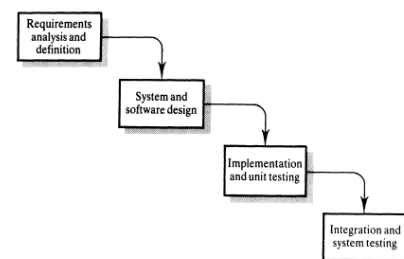
- Early focus on users (cognitive, behavioral, attitudinal characteristics) and tasks
- Actual measurement: observe, record, analyze users' reactions and performance
- Iterative design: find problems, fix them, test again
- Users' involvement in process

## User-centered design

- Affects product acceptance and success
- Makes users active stakeholders
- Manages expectations
- Gets head start on training
- Communicates without sales hype
- Provides vital information about needs, requirements, usability

## Traditional software development “waterfall model”

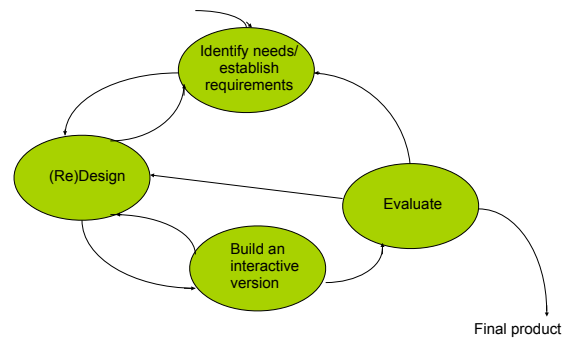
This is *not* how we do user-centered HCI design





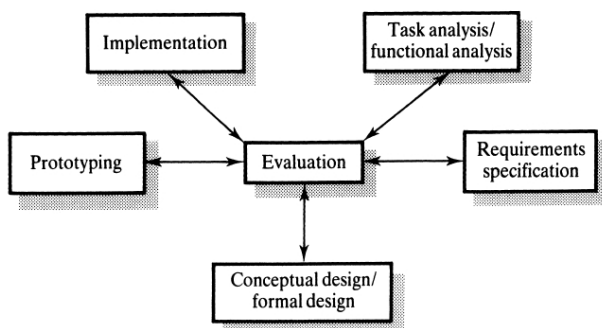
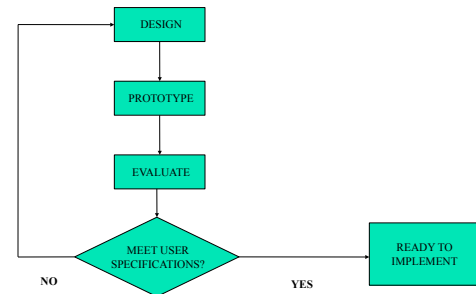
## HCI design process (J. Preece)

- Identify needs, establish requirements
- Develop alternative designs (unlike software design)
- Build interactive versions of designs (prototypes)
- Evaluate designs
- Iteration is inevitable



## HCI design process (McCracken)

- Needs analysis
- User and task analysis
- Functional analysis
- Requirements analysis
- Setting usability specifications
- Design
- Prototyping
- Evaluation



The star life cycle (adapted from Hix and Hartson, 1993).

## Doing user-centered design

- Who are the users (and other stakeholders)?
- What are their needs and requirements?
- Are there external (environmental) considerations?
- Where do we find users to test our design?
- How do we measure success/usability?



## Identify all the stakeholders

- Primary (directly interacting) users, but also:
- Secondary users (e.g., grocery customer)
- Managers
- Recipients of product's results
- Purchasing decision makers
- Competitors' users

## Human users are diverse

- Physically (hand size, height, strength, coordination, disabilities)
- Cognitively
- Culturally
- Experientially
- Motivationally

## Needs and requirements

- Want to understand users, task, context
- Kinds of requirements
  - Functional: what it does
  - Non-functional: e.g., memory reqts, delivery time
  - Data: what info is stored, in what form
  - Environmental: physical, social, org'l context
  - User: what users will be like
  - Usability: what balance of factors

## Gathering requirements data

- Questionnaires
- Interviews
- Workshops and focus groups
- Naturalistic observation
- Studying documentation
- Choose based on kind of task, on data provided, cost, time required, what analyst needs to know

## Problems gathering data

- Identifying, involving stakeholders
- Availability of key stakeholders
- Ownership of reports, versions
- Communication (with users, within team)
- Domain info hard to get or articulate
- Political problems in organization
- Changes in economic or business situation

## Data gathering guidelines

- Focus on identifying stakeholder needs
- Involve all stakeholder groups, more than one person from each
- Combine techniques; use props, prototypes
- Run a pilot session (user testing!)
- Decide how to record data (audio, video, notes)

## Data analysis

- Don't let data get stale
- Do this iteratively, too
- Decide which tools, how much formalism
  - Quantitative vs. qualitative
  - Scenarios (narrative) and personas
  - Use cases (describe interaction with system, alternative paths)
  - “Essential use cases,” “hierarchical task analysis” (more formal methods)

Le mieux est l'ennemi du bien.  
(The best is the enemy of the good.)

— Voltaire

[“Dramatic Art” in *Philosophical Dictionary*, 1764]

## HCI design process (again)

- Identify needs and requirements (using some evaluation techniques, e.g. observation)
- Design alternative solutions
- Build interactive prototypes
- Evaluate the prototype designs
- Repeat as needed
- Implement the final design

## Generating alternative designs

- No automatic way to come up with ideas
- What kind of interaction (instructing, conversing, manipulating, exploring)?
- Look at similar systems, at very different systems
- Build up your repertoire, your toolbox; expose yourself to a lot of things.
- Techniques: brainstorming, attribute listing and variation, ...

## Prototyping

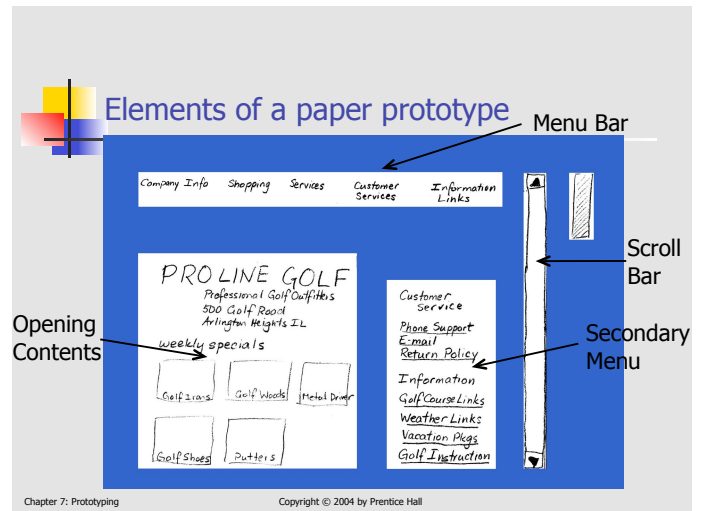
- Present ideas for evaluation without getting in too deep (in time, money, commitment)
- Use sketches, storyboards, slide shows, video simulations, physical objects, mock-ups, skeleton software
- Build model of work flow, task design, screen layout, information display, difficult or critical aspects

## High-fidelity prototyping

- Same materials as final product
- Realistic-looking results
- Tools include MacroMedia Director, Dreamweaver, VB, ...
- Users' expectations and focus?

## Low-fidelity prototyping

- Unlike the final form
- Quick, cheap, easily changeable
- Examples
  - Sketches
  - Index cards
  - Storyboards
  - Sticky notes
- Paper prototyping • • •



## Prototyping considerations

- Models necessarily omit detail
- Horizontal vs. vertical approach (breadth vs. depth)
- Other tools
  - “Wireframe” systems (e.g., balsamiq.com, gomockingbird.com)
  - Scripting languages (e.g., Tcl/Tk)

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## How do we organize information?

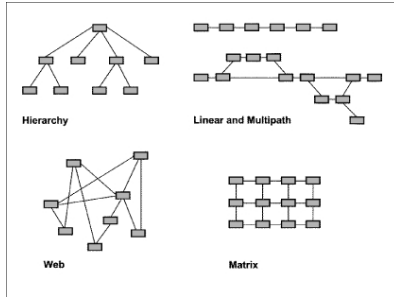
- How do users group concepts together?
- How do we name the groups? (McCracken: organizational scheme)
- How do the groups relate to each other? (McCracken: organizational structure)

## Organizational schemes

- Exact: alphabetical, chronological, geographical
- Inexact/ambiguous: topical, task-oriented, audience-specific
- Combinations

## Organization structures

- Shape can be hierarchical, linear/multipath, network/web, matrix
- Unrestricted linking makes orientation hard
- Network/web structures hard for beginners
- Database •



## Hypermedia and the WWW

- Nodes (info in many media)
- Visible links to other nodes
- HCI view: navigation between pages, information presentation, multimedia layout
- More than just HCI design • • • •

## Visual organization principles

- Use proximity, alignment, consistency, contrast to good effect
- More closely related things should be closer, aligned, consistent
- Less closely related: further, contrasting
- Every difference (in size, color, type, placement) should have a reason or meaning

## General screen guidelines

- Reflect structure of task, not of implementation
- Group info for coherent subtask on one screen
- With multiple, related screens
  - Use same headlines
  - Present necessary info on each screen in same place
  - Allow navigation to previous screen, access to help, ability to exit subtask or whole program

## Special screen areas

- Title at top, distinguished
- Can use bottom for status info, explanation, warnings
- Logos typically upper left or upper right
- Clocks (no seconds, no ticking)
- Special meanings: Home, Search, Contact, About, Check Out

## Screen layout

- Use proximity, alignment, consistency, contrast
- Use adequate whitespace (60%–80%)
- Alternatives to whitespace for grouping:
  - Lines
  - Boxes
  - Colored/shaded backgrounds

## Site navigation, advance info

- What's possible now? What will happen next?  
What can I do now?
- Prevent errors, unexpected results
- Guidelines
  - Give visual indicators, not just text •
  - Distinguish unselectable menu items, objects
  - Change cursor shape •
  - Show submenus on rollover •
  - Show data entry format ••
  - Indicate long operations, ask permission •

## HCI for Web (Farkas & Farkas) 2

- 3.1: Clear, conspicuous orientation at top •
- 3.2: Support exploration ••••
- 4.1: Use site maps for structure and direct access •••
- 4.2: Provide search facility or index for direct access
- 4.3: Provide links to home page throughout

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## HCI for Web (Farkas & Farkas)

- 1.1: All links indicate they're links •
- 1.2: Help viewers notice links
- 1.3: Links clearly indicate destinations
- 2.1: Effective breadth and depth in hierarchies •
- 2.2: Add secondary/shortcut links where approp.
- 2.3 Allow branches to converge where approp.
- 2.4 Reveal underlying information structure •

## Activity: Airline Home Page

- Form groups of about 5 people: 5min
- List all the info an airline might want on its web site (brainstorm; create a long list): 10min
- Select/organize/arrange the site info; design home page with links/menus/nav bars
  - What do different users need or expect? 10min
  - What info should be on the home page itself? 10m
  - Use alignment, proximity, etc. to lay page out: 15m
- Sketch design on board or transparency: 5 min
- Write all members' names with sketch

## Evaluation

- Formative vs. summative
- Four paradigms
  - Informal feedback
  - Walkthroughs
  - Field studies
  - Predictive evaluation
- Goals: find problems or new opportunities, check conformity with guidelines, standards, requirements, ...

## Evaluation planning

- Determine high-level goals
- Explore questions to be answered
- Choose evaluation paradigm and techniques
- Identify practical issues
- Decide how to handle ethical issues
- Evaluate, interpret, and present results

## Designing a study

- Reliability: results are repeatable
- Validity: measuring what you want to measure
- Biases: should not be introduced by process
- Scope: breadth of findings' applicability

## Interviews

- Structured/scripted vs. unstructured/open-ended
- Avoid long, compound questions
- Avoid unfamiliar terms
- Avoid questions that embody assumptions
- Avoid biases
- Intro, warm-up, main body, cool-off, closing

## Questionnaire development

- Paper vs. electronic, closed vs. open-ended
- Checkboxes, rating scales, prose responses
- Design
  - Start off-line even if goal is electronic
  - Questions all positive, all negative, mixed
  - Pilot-test questions for clarity, sufficient space
  - Consider analysis

## Increasing questionnaire response

- Expect 20%–40% rate (less online)
- Make purpose clear
- Promise anonymity
- Design well
- Offer short version
- Provide stamped return envelope
- Follow up
- Provide incentive

## Expert critiques

- Heuristic evaluation w/ guidelines (Nielsen)
  - Brief 3–5 experts
  - Each works separately 1–2 hours, two passes
  - Debrief experts together
- Cognitive walkthrough
  - Tell expert assumptions, context, task
  - Expert walks through prototype w/ usage scenarios
  - Will user know what to do? Will user see correct action is available? Will user understand response?

## Observing users

- In the lab
  - Walkthroughs with low-fi prototypes
  - Instrumented sessions with higher-fi systems
- In the field
- Consider, as always, who's involved, their goals, their actions, their feelings, the relevant objects and events

## Usability walkthroughs

- Make an explicit test scenario (test plan)
- Test the test (pilot study)
- Recruit subjects
- Conduct test
- Debrief subjects

## Roles in walkthroughs

- Greeter gets user settled
- Facilitator talks to user during testing
- Computer (a person) manipulates interface elements
- Observer(s) take notes

## User testing

- A part of usability testing
- Smaller-scale, less formal, more focused than full-blown usability research
- Can be quantitative: time to complete, number of errors, number of help requests, number of users completing task successfully
- Can include keystroke-level monitoring
- How many users?

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## Interaction styles (traditional)

- Command entry
- Menus
- Direct manipulation
- Form fill-in
- Natural language



## Interaction styles (new)

- Immersive/virtual reality
- Ubiquitous computing
- Robotics



## Conceptual models for activities

- Giving instructions
- Conversing
- Manipulating, navigating
- Exploring, browsing

## Direct manipulation

- GUI objects representing task objects/functions
- Pointing device
- Based on consistent metaphor
- Congruent operations, always available
- Immediate feedback
- Form of icon, cursor on rollover indicates possible operations

## Feedback

- User action, system reaction (ideally < 0.1 sec)
- Guidelines
  - Highlight items on rollover
  - Mark selected items •
  - Show path in navigation hierarchy
  - Report errors immediately
  - Use status or progress indicators
  - Use visual, auditory, and tactile modes
  - Make reaction time uniform

## Undo

- Encourages users to explore functionality
- Guidelines
  - Special-purpose undo (e.g., backspace) supplements general
  - Try to make everything undoable (external effects clearer to users than internal)
  - Multiple undo (undo/redo or linear sequence)

## Error avoidance

- Provide advance information
- Keep dangerous controls away from frequently used ones
- Warn users of irreversible effects; don't make them the default; request confirmation
- Turn safety options on by default
- Recognize errors and react ASAP

## Error messages and actions

- Explain nature of problem, how user can solve it (at least with correct examples)
- Describe in terms of user's task
- Use polite language • • •
- On crash, give opportunity to save
- Support force quit and relaunch

## Shneiderman's error message guidelines

- Avoid "fatal," "invalid," "bad"
- Avoid ALL CAPS, cryptic numbers
- Give control over audio feedback
- Give precise messages
- Provide context-sensitive help

## Quick activity: Silencing cellphones

- Form groups of 2, 3, or 4.
- People forget to silence their cellphones in class, meetings, movies. They forget to turn them back on when they're done. **Come up with an interface to help with this.** (10 min.) Assume you have a smartphone with GPS, calendar, and other apps you can create.
- Write members' names, very brief notes/sketch
- Each group presents (60 seconds max)

## Help: different types

- Tutorial or getting-started manuals
- Guided tours
- Reference manuals
- Reminders (reference cards, keyboard templates, rollovers)
- Wizards (to walk through tasks)
- Tips
- On-line help (searchable)

## Online help

- Available, consistent for all system functions
- Including currently unavailable options
- Situation-sensitive and concrete
- Written in terms of user's task
- Not obscuring relevant items; movable
- Initially short, with details on request
- Good ID reduces need for explicit help

## Tours, tutorials, manuals

- Tour should be short, hit highlights
- Encourage active learning (e.g., user actions, quizzes), address users directly, give examples
- Manuals are last-resort, comprehensive sources
- Use tech writing specialists where possible

## Form design guidelines

- Allow entry in tables or labeled data fields •
- Left-align labels, fields, columns in tables •
- Arrange sequences in columns •
- Use meaningful, unambiguous labels
- Mirror layout of paper source document
- Use adequate white space • •
- Tell user expected form of data; indicate if required; allow “N/A” or “other”
- Allow enough space for expected data

## Data entry in forms

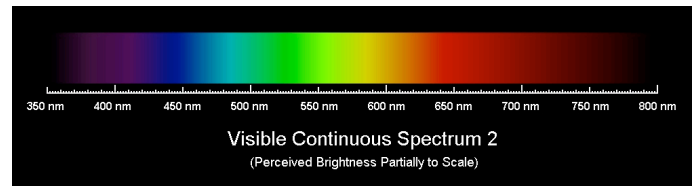
- Tab or return should move to next field
- Fill fields with default/most recent/inference
- Allow entry in arbitrary order
- Allow abbreviation/expansion
- Show alternatives if entry not unique •
- Don't supply dangerous values as auto entries
- Detect, indicate, explain errors; allow multiple corrections
- Don't require re-entry of correct data

## Color

- Adds information, interest, emotion
- Ways of thinking about color (color models)
- Color harmony schemes
- Text and background
- Most illustrations from McCracken and Wolfe, *User-Centered Website Development*

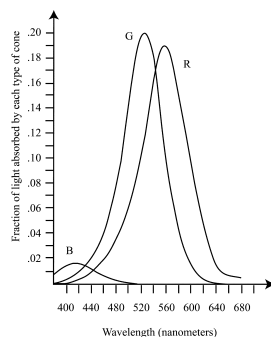
## Spectrum of visible light

- Wavelengths ~350 – ~800 nanometers
- Small part of whole electromagnetic spectrum (radio, microwave, ..., X-rays)



## Perception depends on physiology

- We respond less to blue because there are few blue cones, especially in fovea
- The most common form of color-blindness doesn't distinguish red and green



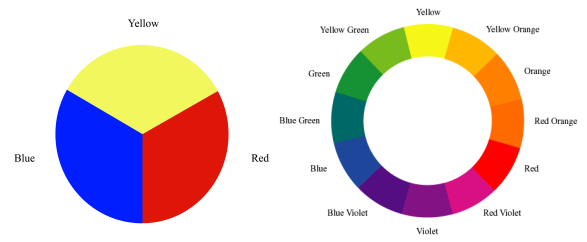
## Alternative models/representation

- 12
- twelve
- XII
- 十二
- douze
- ~~||||~~ ~~||||~~ ||

## Color models

- **RYB:** red-yellow-blue (artist's color wheel)
- **RGB:** red-green-blue (additive color)
- **CMYK:** cyan-magenta-yellow-black (subtractive color)
- **HSB:** hue-saturation-brightness
- **Lab:** luminance - green/red - blue/yellow

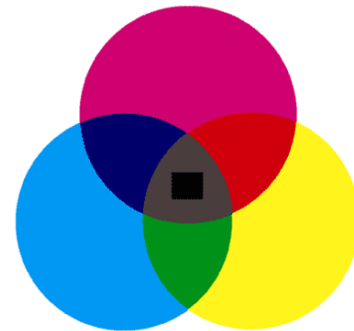
## R Y B



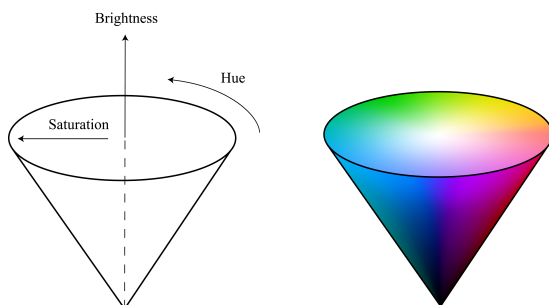
## RGB



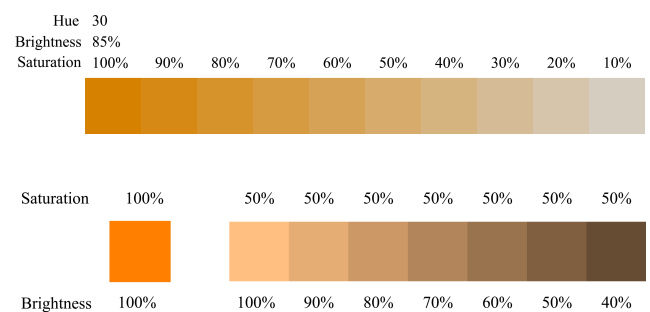
## CMYK



## HSB



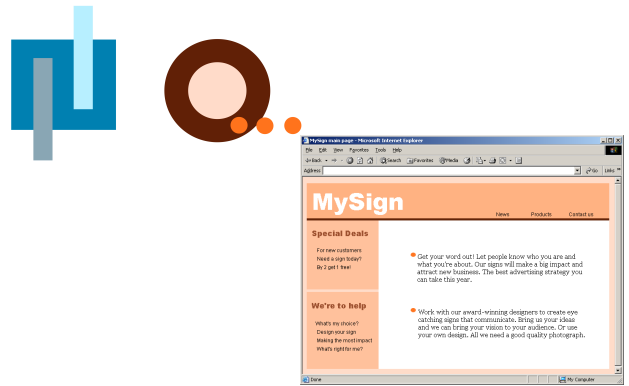
## Saturation vs. brightness



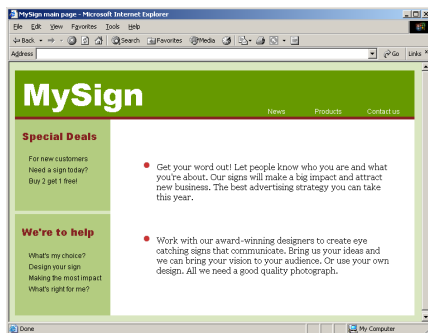
## Color harmony schemes

- Monochromatic (all same hue)
- Complementary (opposite on color wheel)
- Analogous (adjacent on color wheel)
- Triadic (three colors evenly spaced on wheel)
- Tetradic (four colors, two pairs)
- See [kuler.adobe.com](http://kuler.adobe.com), [colorshemedesigner.com](http://colorshemedesigner.com)
- These can be approximate, but ignore at your peril

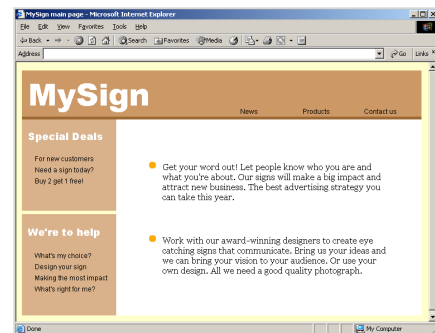
## Monochromatic



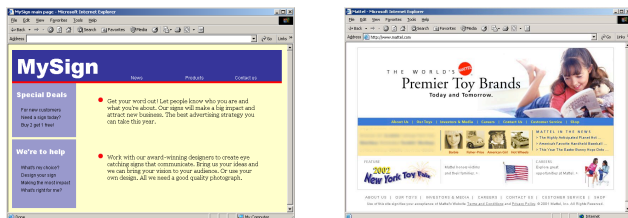
## Complementary



## Analogous



## Triadic



## Text and background colors

- Provide adequate contrast
- Avoid clashes, especially for extended use
- Dark on light is better than light on dark

## Color depends on context

- Perception varies based on what other colors are nearby •
- Cultural connotations

## Recommended uses of color

- Emphasis, grouping (especially as background)
- Coding discrete or continuous data • •
- Distinguishing window types
- Visual separation of overlapping graphics
- Depth in 3D graphics (red closer, blue farther)
- Warnings, status reports
- Increasing attractiveness, creating emotional response (within guidelines)

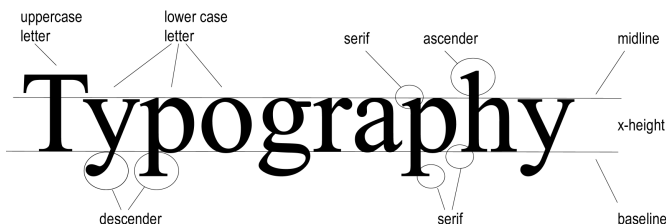
## Color tools

- McCracken/Wolfe textbook website has a tool for color matching and HSB/RGB conversion
- Adobe Kuler ([kuler.adobe.com](http://kuler.adobe.com) •) creates color schemes (requires free Adobe ID); also [colorshemedesigner.com](http://colorshemedesigner.com)

## Typography

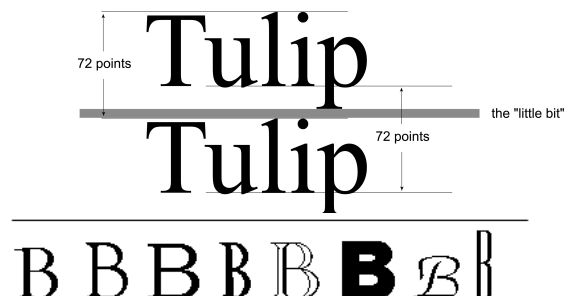
- HCI for documents, affects effectiveness
- Display type vs. body type
  - Quick recognition of letters, words, lines
- Great control now in user's hands
  - “With more power comes the power to mess up in new and more spectacular ways.” — DGK
- Differences between displays and paper
- Less designer control for text on the WWW

## Typography terms



From McCracken and Wolfe,  
*User-Centered Website Development*

## Font size: baseline to baseline



From McCracken and Wolfe,  
*User-Centered Website Development*

## Line spacing (leading) matters

- ♦ The point size is also the distance between successive baselines, assuming no space is added between lines as is commonly done. It is clear that without the “little bit,” the letters in successive lines would touch, seriously hampering legibility.

From McCracken and Wolfe,  
*User-Centered Website Development*

## Serif vs. sans serif

Times New Roman  
Georgia  
Arial  
Verdana

## Monospace vs. proportional spacing

```
f("It's")-1; // Courier  
f("It's")-1; // Andale
```

```
f("It's")-1; // Times  
f("It's")-1; // Georgia  
f("It's")-1; // Helvetica
```

## Typeface guidelines (characters)

- Mix upper and lower case
- Choose proportional spacing over monospace
- Use fonts with varying stroke width
- Choose serif over sans-serif fonts
  - But on the web ...

## Margin justification

The sun did not shine, it was  
too wet to play, so we sat in the  
house all that cold, cold wet  
day. I sat there with Sally, we  
sat there, we two, and I said,  
“How I wish we had something  
to do.” Too wet to go out and  
too cold to play ball, so we sat  
in the house. We did nothing at  
all.

And then something went,  
“Bump!” How that bump  
made us jump! We looked and  
we saw him step in on the mat.  
We looked and we saw him:  
The Cat in the Hat. And he said  
to us, “Why do you sit there  
like that?”

Rag-right

The sun did not shine, it was  
too wet to play, so we sat in the  
house all that cold, cold wet  
day. I sat there with Sally, we  
sat there, we two, and I said,  
“How I wish we had something  
to do.” Too wet to go out and  
too cold to play ball, so we sat  
in the house. We did nothing at  
all.

And then something went,  
“Bump!” How that bump  
made us jump! We looked and  
we saw him step in on the mat.  
We looked and we saw him:  
The Cat in the Hat. And he said  
to us, “Why do you sit there  
like that?”

Flush right

## Typography guidelines (document)

- Keep lines short (10–12 words; max chars 35? 50? 70?)
- Don’t justify margins
  - Extra white space
  - Justification and monospace fonts
- Consider extra leading
- Minimize number of fonts
- Use emphasis minimally



## Graphic design critique

[www.ics.uci.edu/~kay/whatswrong.pdf](http://www.ics.uci.edu/~kay/whatswrong.pdf) •

## Multimedia

- Text, images, audio, animation, video
- Hyperlinks and multimedia pretty much characterize the web

## Audio

- Recall audio/visual/kinesthetic learning modes
- Supports people with vision limitations
- Conventional audio: Download whole file before playback
- Streaming audio: Start playing before download has finished

## Audio guidelines

- Have text alternative for audio language
- When mood-setting, keep volume low
- When getting attention, keep audio brief
- Have a mute button

## Video

- If a (still) picture is worth a thousand words ...
- But it requires high bandwidth (i.e., it's painfully slow on slow connections)
- Download time depends on
  - File size: pixels per frame (e.g., 320 x 240) and bits per pixel (e.g., monochrome v. color)
  - Transmission rate (e.g., 56Kb/sec dialup)
- People lose attention after 10 seconds (but that's not absolute)

## Video recording guidelines

- Use a tripod
- Use a neutral background
- (These also improve compression)
- Get in close to your subject

## Animation

- Synthesized moving images
- Can be more compact than video
- Can enable more interactions than video

## Information visualization

- Allows understanding of huge amounts of data
- Allows perception of unanticipated properties
- Reveals problems with data itself
- Facilitates understanding of large- and small-scale features of data
- Facilitates hypothesis formation

Ware, *Information Visualization*

## Edward Tufte (Yale)

- *The Visual Display of Quantitative Information*
- *Envisioning Information*
- *Visual Explanations*
- *Beautiful Evidence*

## Tufte on graphical integrity

- Make physically measured representation proportional to quantity being represented
- Use clear, detailed, thorough labeling
- Show data variation, not design variation
- Deflate and standardize monetary figures
- Dimensions in representation  $\leq$  dimensions in the data
- Don't quote data out of context

## Tufte on producing data graphics

- Above all else show the data
- Maximize the data-ink ratio
- Erase non-data-ink
- Erase redundant data-ink
- Revise and edit

## Tufte on graphical excellence

- Well-designed presentation of interesting data—substance, statistics, design
- Complex ideas communicated with clarity, precision, efficiency
- Greatest number of ideas in the shortest time with the least ink in the smallest space
- Multiple variables presented
- Data represented truthfully

## ICS 4 Overview

- The field of HCI
- Human characteristics
- User-centered design
- Content organization and navigation
- Evaluation strategies
- Building blocks (color, typography, ...)
- The broader context

## Vision

- Blindness, impaired vision, color blindness, photosensitive epilepsy
- Technologies
  - Screen-reading software
  - Braille “displays”
  - Descriptive audio
  - Screen magnifiers (software, hardware)
  - Vischeck.com • (software to simulate and compensate for color blindness)

## Mobility

- Trouble with keyboard and/or mouse
- Caused by disease, injury, RSI, aging
- Technologies
  - One-finger sequential typing for, e.g., Ctl-X
  - Ignore brief or repeated keystrokes
  - Move pointer using keyboard
  - Predictive typing; cycle-until-stop
  - Head/foot/mouth/gaze/speech control devices

## Accessibility

- The Web isn’t truly world-wide if it’s not accessible to the millions of people who have difficulties with vision, hearing, cognition, movement, ...
- Accessibility isn’t simple, but tools are available and progress is being made

## Hearing

- Technologies
  - Captioning
  - American Sign Language (automatically generated by an animated avatar, [asl.cs.depaul.edu](http://asl.cs.depaul.edu) •)

## Guidelines and legal requirements

- Web Accessibility Initiative, ([www.w3.org/WAI/](http://www.w3.org/WAI/) •)
- Americans with Disabilities Act (ADA) •
- 1998 amendment to Rehabilitation Act of 1973 ([www.section508.gov](http://www.section508.gov) •)
- Institutional directives (e.g., UCI’s Electronic Communications Policy)

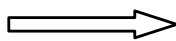
## Evaluation of accessibility

- Try turning off images, sound, Java
- Try larger-than-normal font sizes
- Try smaller-than-normal screen or window
- Try monochrome display
- Try it without a mouse
- Try it with a text-only or voice browser
- Use Wave •, Bobby •, A-Prompt • tools
- Do user testing

## Don't rely on automated translation

- For 60 years, a goal of computing (still unmet)
- It's far tougher than dog = perro = chien = 犬
- Idioms, nuances, cultural issues, non-overlapping grammatical categories
- Not just waiting for the next, faster machine: We just don't know enough about language
- (You shouldn't rely on the grammar checker in Word, for the same reason)
- Use professional human translators

## Why is natural language hard?



UNDERSTANDING  
(APPROP. RESPONSE)

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• It's hard to recognize speech<ul style="list-style-type: none"><li>– Continuous</li><li>– Individual differences</li><li>– Rapid speech</li></ul></li></ul> | <ul style="list-style-type: none"><li>• Understanding (even written language) is harder still<ul style="list-style-type: none"><li>– Paraphrase</li><li>– Ambiguity (disambiguate by providing context)</li></ul></li></ul> |
|---|---|

## Globalization

- They don't call it world-wide for nothing
- Internationalization: Identify and isolate culture-specific items
  - Text
  - Numbers (34.50 vs. 34,50, \$ vs. £, units)
  - Dates/times (y/m/d, AM/PM, time zones)
  - Colors (different cultural connotations)
- Localization: Translate or create text appropriate to a given location

## Other tricky cultural issues

- Icons: Symbols and gestures differ
- Addresses
- Reading direction —> page layout
- Space for text (Exit, Salir, Quitter, Verlassen)
- User testing: in target locale and language

## Personalization

- “Welcome back, Joe.”
- “Weather in Irvine, California”
- “Here are some recommendations for you”
- “View your order history”
- “Save your ordering information?”
- Web sites that know something about you can be useful

## Privacy

- But what if that information falls into the wrong hands?
- Security breaches: rogue or careless employees, system break-ins, laptop theft
- Theft, ID theft, embarrassment, unwanted ads
- The laws regulating privacy are a patchwork
- Practically, it's about trust, not law: If users don't trust you, they won't use your site

## How to foster trust

- List what security precautions the site takes
- Observe good business practices (follow through on delivery dates, return policy, ...)
- Have a privacy statement: what info is gathered, how it will be used, allow opt-in or opt-out of use

## Copyright law and the web

- Don't count on any of these to excuse you from copyright infringement:
  - I could view it and download it, so I can put it on my own web page
  - I'm not doing it for money
  - It's for educational purposes
  - I copied less than 10% of what's there

## What affects trust?

- If less is at risk, less trust expected
- Perceived similarity: Users trust sites they think reflect concerns similar to their own
- Status or standing: Social leader endorsement
- Consistent behavior: Actions match words?
- Certification: Doctors, e.g., are licensed
- Referrals: Users are likely to trust someone they know (or someone like them, as above)

## Privacy more broadly

- Why it's a particular issue with IT
- Computer matching and inferences
- Privacy advocates' principles
  - Data used only for purposes it was collected for
  - No systems whose existence is secret
  - Subject's right to see/correct/amend (exceptions)
  - Responsibility of record-keeper to safeguard security and integrity

## Intellectual property law

- Patent law and copyright law: From the U.S. Constitution, to promote progress
  - Patents: Inventions
  - Copyrights: Any form of expression (not the underlying idea)
- Trademark and trade secret law: To promote "fair play" in business
  - Trademark: I can't call my company "Macrosoft"
  - Trade secret: I can't steal your business secrets

## U.S. Constitution

The Congress shall have power “to promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.” [Article 1, sec. 8, cl. 8]

- Financial incentive to create
- Authors can make a living, quit their day jobs
- Works are published, so others can learn

## Copyright protections

- Automatic once work is in tangible form
- Copyright notice helpful, not required  
Copyright © 2011 by Willa Webmaster. All rights reserved.
- Registration optional (but easy, cheap, useful)
- Author exclusively may: reproduce, distribute, create derivative works, display publicly
- Infringement is unauthorized copying or use, typically inferred from evidence of access and substantial similarity between the works

## Defenses to copyright infringement

- Copyright protects expressive form, not underlying ideas
- Independent creation
- Public domain
- Aspects dictated by external constraints
- Copying by “implied license”
- “Fair use” ...

## The “fair use” defense

- Doesn’t just mean it’s okay if it seems fair
- Precise meaning is not cut and dried
- Courts consider four aspects:
  - Purpose/character of use (profit? convenience?)
  - Nature of the work (fiction? fact?)
  - Amount/substantiality of copied portion
  - Effect of copying on work’s value/potential market

## Copyright issues

- How far are user interfaces protected?
- Enforcement, especially across the web
- Ownership and “works for hire”
- Expanding copyright terms
- Content providers vs. content consumers
- Digital Millennium Copyright Act
- Framing and linking

## Copyright references *[not required]*

- Copyright office, [www.copyright.gov](http://www.copyright.gov)
- Electronic Frontier Foundation, [eff.org](http://eff.org)
- UC Copyright Education Web Site, [www.universityofcalifornia.edu/copyright](http://www.universityofcalifornia.edu/copyright)
- Lawrence Lessig, [www.lessig.org](http://www.lessig.org)

## The web's near-term future

- Web-based applications
- Cloud computing
- Mobile devices
- Continuous sensing
- Games (entertainment, training, simulation)

## End-of-quarter logistics

- If you have review questions for the final
  - Use piazza.com or ics4@uci.edu.
  - Review session, Monday 18 March, 1:00-2:50, DBH 1500 (bring or Email written questions)
- Final exam
  - Tuesday 19 March, 10:30–12:30, DBH 1600 (here)
  - Covers the whole course, more or less evenly
  - Mostly similar to midterm in form
  - You may bring any paper materials, as before
- Please do the course evaluation on EEE

## Questions?

## ICS 4 Overview

- The field of HCI
- Human characteristics
- User-centered design
- Content organization and navigation
- Evaluation strategies
- Building blocks (color, typography, ...)
- The broader context

## Looking forward

- ICS 3, Internet & Social Impact
- ICS 5, Environmental Issues in IT
- ICS 7, Modern Computational Tools
- ICS 8, Practical Computer Security
- ICS 10, How Computers Work (Summer I)
- ICS 11, The Internet and Public Policy
- ICS 60, Comp. Games and Society
- ICS 105, Digital Information Systems
- Informatics 131, HCI (Summer I)
- Informatics 143, Information Visualization
- Informatics 161, Social Analysis of Computing