Informatics 131
Human-Computer Interaction

David G. Kay
kay@uci.edu
http://www.ics.uci.edu/~kay/courses/131/Slides.pdf

Acknowledgements and caveat

These slides draw liberally, with permission, from the Informatics 131 slides of Prof. Alfred Kobsa, available in their original form at www.ics.uci.edu/~kobsa/courses/ICS104/course-notes/notes-all.pdf

Caveat (beware): At best, PowerPoint slides are only a pale imitation of the entirety of a class meeting. In Informatics 131 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?

- User interfaces matter: for efficiency, for convenience, for commercial success, even for life and death
- Everyone has stories of bad user interfaces
- Further examples •

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

Six aspects of HCI

- Human abilities (perception, memory, …)
- Technologies (windowing, mouse, VR, …)
- 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 (Infx 132)

Informatics 131 Overview

- The field of HCI
- Human characteristics
- Menu of technologies
- Development and evaluation methodology
- Guidelines and results

Informatics 131's place in the spectrum

- ICS 161 [eternal]
- CS 151-2, 132-3, 141-2A-3A [verifiable but subject to technology changes]
- Informatics 111-3-5, 121-2-3 [software focus]
- Informatics 131 [user focus]
- Informatics 161 [social focus, few experiments possible]

How did we get here?

- Once, just working (usually) was enough
- 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 goals

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

Usability principles/heuristics (Jakob Nielsen)

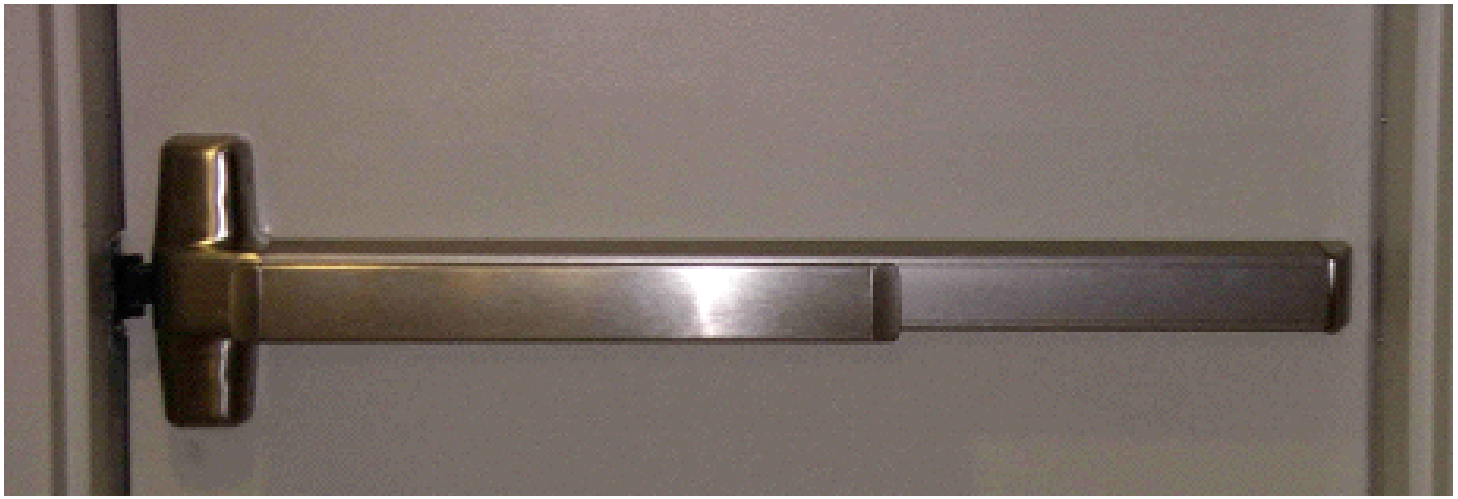
- Visibility of system status
- Match between system and real world
- User control and freedom
- Consistency and standards
- Error prevention
- Recognition over recall
- Flexibility and efficiency of use
- Aesthetic and minimalist design
- Help users recognize, diagnose, and recover from errors
- Help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

Affordances: giving a clue

- What the user can see that an object does
- Chairs afford sitting; handles afford pulling
- On screen, affordances are just perceived
  - E.g., buttons and scrollbars—clear to novices?
  - Learned conventions
  - 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

Text

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

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 •

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

Cognition

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

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 •

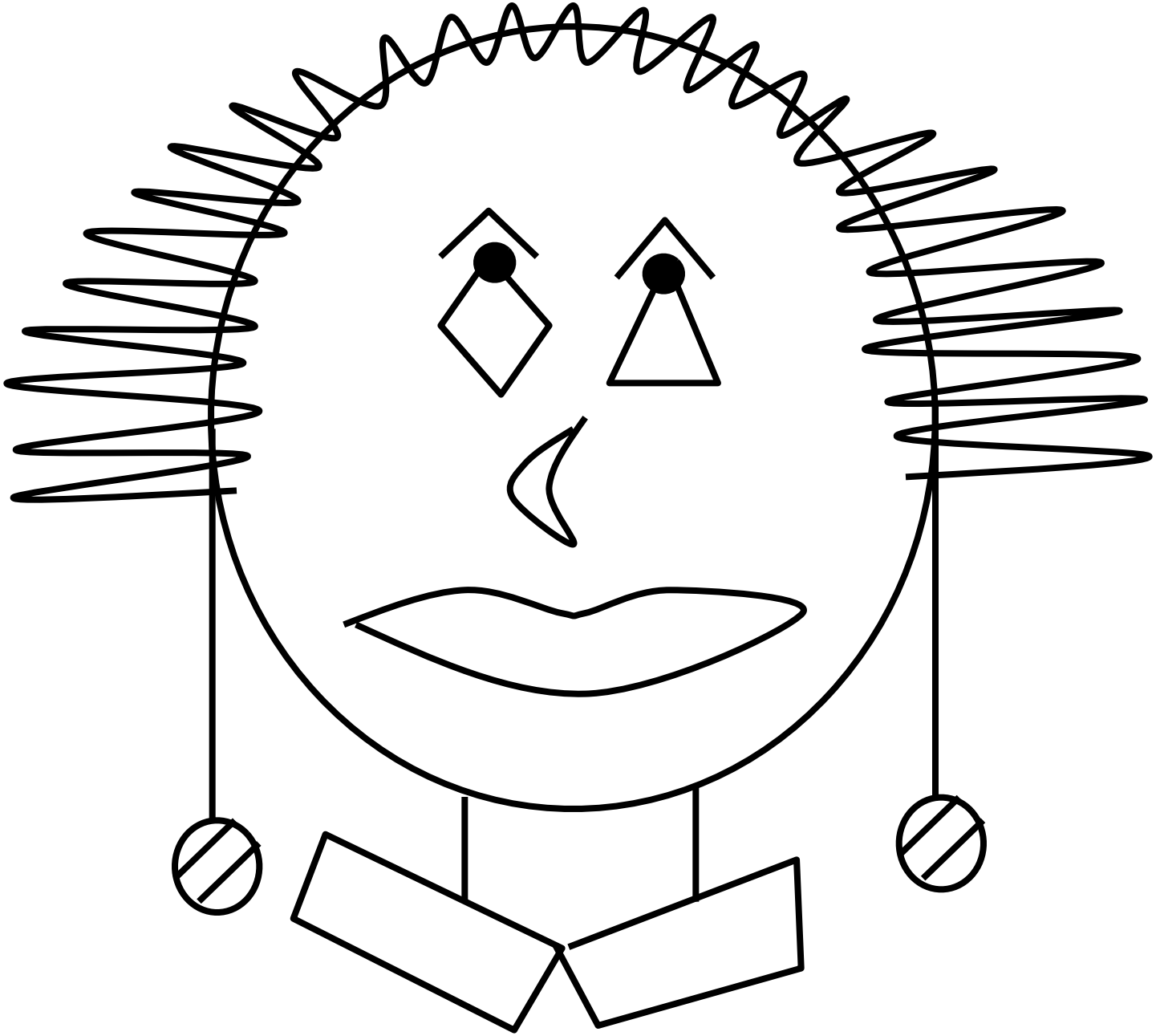
Gestalt laws

- Whole picture, perception in context
- Proximity •
- Similarity •
- Closure •
- Continuity • •
- Symmetry •

Learning modes (sensory input)

- Visual
- Auditory
- Kinesthetic

- Exercise from Saundra Sparling



Graphical coding

If we use differences in

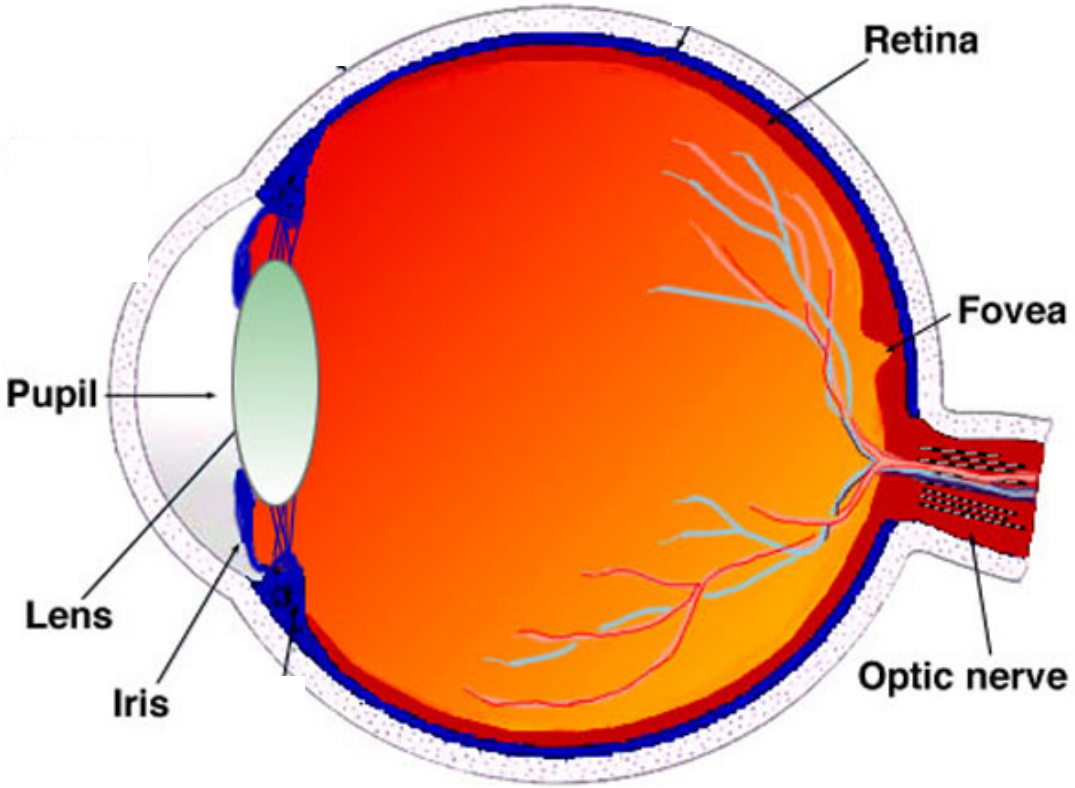
color / shape / words / line width / size / …

to distinguish objects or convey meaning,
what are the strengths and limitations?

Table from Maguire (1987) •

Human vision for color

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



The retina

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

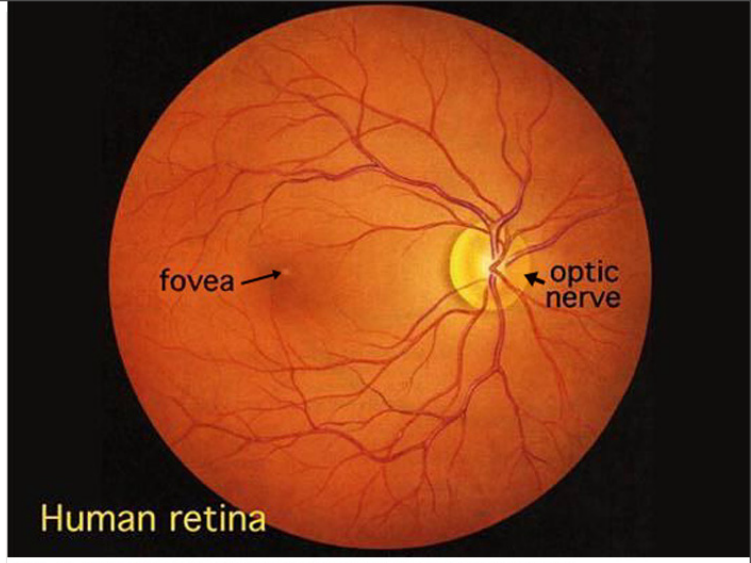
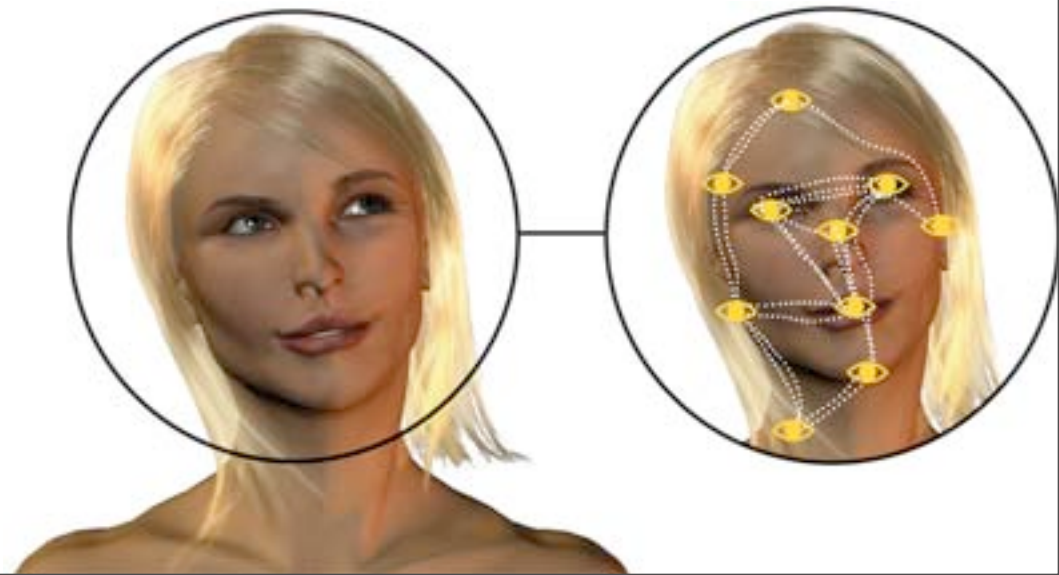


Fig. 1. Human retina as seen through an opthalmoscope.



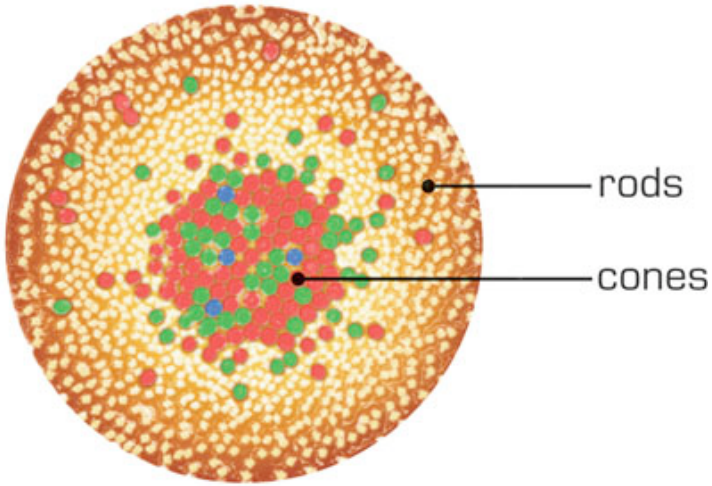


Photo-receptors in retina

- 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

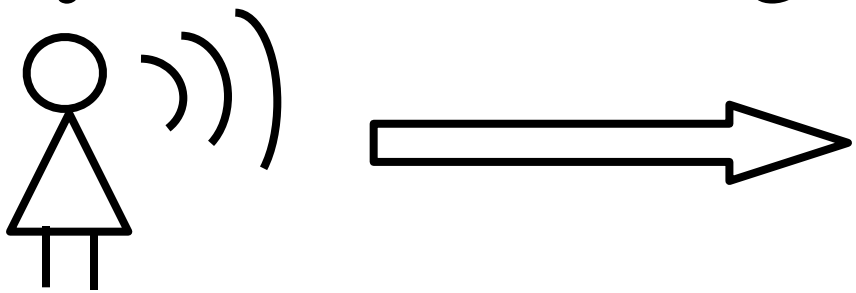
Menu selection time

- 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, S ~ *n*
  - if label known, search linearly or randomly; in either case, S ~ *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 (along the axis of movement—how much can you miss 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

Why is natural language hard?



UNDERSTANDING
(APPROP. RESPONSE)

- It's hard to recognize speech
  - Continuous
  - Individual differences
  - Rapid speech
- Understanding (even written language) is harder still
  - Paraphrase
  - Ambiguity (disambiguate by providing context)

How interfaces affect users

- Design to evoke positive responses
  - Feel at ease, enjoy experience, trust system
- Avoid user frustration
  - Gimmicks, error messages, overburdened users
- Anthropomorphism

Communication & collaboration

- People work in a social context
- Rules and conventions for social interaction
  - Conversation (facilitate flow)
    - Synchronous, asynchronous
  - Coordination (facilitate action)
  - Awareness of status
- Computer-supported cooperative work
- Ethnography: Observe people and describe

Ways to look at social interaction

- Language/Action (speech acts)
  - Assert, commit, declare, direct, express
  - Winograd/Flores system
- Distributed cognition
  - Information flow between people, artifacts

HP Cooltown • (ubiquitous comp.)

- What inferences does the system make?
- What connections are necessary?
- What are possible pitfalls?
- What's your (emotional) reaction?