COMP352/552: Human Computer Interaction

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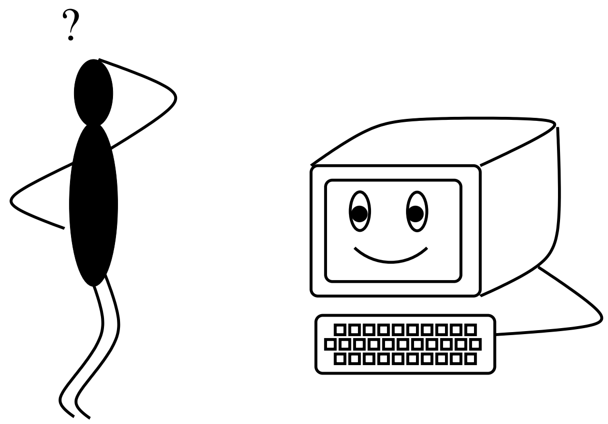
- Two main topics:
  1. Principles of Human Computer Interaction
  2. Techniques to Design the User Interface
- 15 lectures, no practicals
- assessment method: 100% examination:
  - 5 (mandatory) theoretical questions
  - 2 out of 3 practical exercises
- Books:
  1. C. Faulkner, *The essence of Human Computer Interaction*, Prentice Hall, 1998.
  2. B. Shneiderman, *Designing the User Interface*, Addison-Wesley, 1998 (3rd edition).
  3. I. Horrocks, *Constructing the User Interface with Statecharts*, Addison-Wesley, 1999.

`http://www.csc.liv.ac.uk/˜floriana/COMP352/`

What on earth is it?

User and system: two complex entities that have to interact.

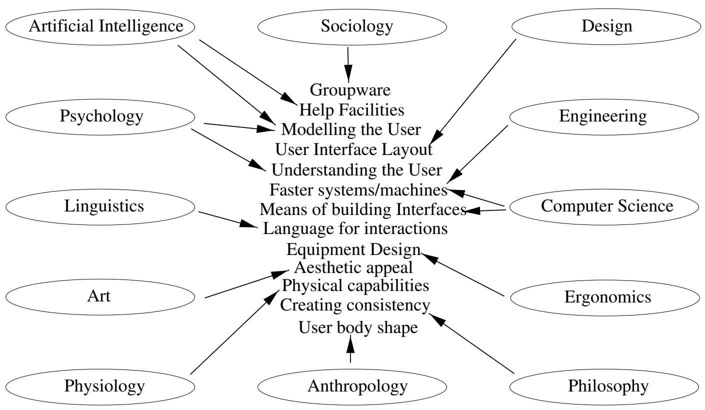


HCI aims to understand both the user and the computer system in order to make the interaction between the two easier and more satisfying.

Designing systems for people

- Emphasis on the user
- The interface IS the system for most of the users!
- The system has to make users more efficient than they would be if they performed their task with an equivalent manual system.
- User are experts in their particular field, and not necessarily computer experts (nor they should become!).
- Produce systems that are natural and transparent to use, not involving the user in significant amount of learning time and effort: the user should ideally forget about the computer system and concentrate on the task alone.

HCI: an interdisciplinary field



We can't address all the issues!

Mainly focus on:

- characteristics of the user that might be useful for design
- how to evaluate a good interface
- when the interaction works (and when it doesn't): guidelines
- how to design an interface (as a piece of software)

Mainly leave out:

- ergonomics
- health and safety
- social issues
- devices and tools ("disappearing computers")

HCI course: instructions

- half of the course describes techniques
  - understand the main principles and try to apply to concrete cases
  - knowledge ecology: we'll try to reuse what you know (e.g. StateCharts) but from another point of view
- but the other half is based on "guidelines"!!
  - do not learn things by heart!
  - construct your own knowledge
    (added value answers to exam questions!)
- no courseworks, but plenty of things around!
  - observe, try, evaluate, compare, contrast
  - try end of week exercises
  - a real case study: analysis of a web site

it's an *awareness* course

Understanding the user: Physical Capabilities

- humans perceive the environment through the senses: vision, hearing, taste, smell, touch.
- visual ability is particularly important for most of the computer systems
- in normal daylight conditions, visual acuity is best at the front of the eye: in order to examine an object, the eyes will be moved until the object is in focus on the front of the retina.
- at the periphery of vision, a person may be aware of the presence of an object, without recognizing what it is.

Perception of colours

Our visual system is able to respond to wavelengths in the region of 400 to about 750 nanometers. This is called **visual spectrum**. Colour is classified according to:

Hue: the actual experience of the colour, as we normally think of it. Hue varies according to wavelength: for example, at 465nm we have the pure blue, at 500nm the pure yellow etc. Red is extraspectral, as it is not produced by a single wavelength but by a mixture of them.

Brightness: subjective response to light.

Saturation: how much a colour is chromatic rather than achromatic (the more black, grey or white is mixed with the colour, the less saturated it becomes).

Other visual parameters

Contrast: it is the relationship between the light emitted from an object and the light emitted from the background. Generally, the lighter the background, the darker the object will appear.

Luminance: it is the light reflected from the surface of an object. The greater the luminance, the more the eye can perceive detail: the diameter of the pupil decreases and this increases the depth of focus. Also, the eye becomes more sensitive to flicker. The brighter the screen, the more likely we see flicker. Also, the eye is more sensitive to flicker at the periphery of vision, so the larger the screen the more likely is to see flicker out of the corner of the eye.

Implications for design

- the visual field is important to the definition of the size of the screen layout: too much movement of the head can cause discomfort and may increase the chance of eye strain if refocusing needs to occur
- at the periphery of vision, the eye is least sensitive to red, green and yellow light and most sensitive to blue (blue makes a good background colour)
- at the front, the eye is most sensitive to red and yellow and least sensitive to blue (small, esp. pale blue objects tend to disappear on the screen).
- small changes in blue are more difficult to distinguish then small changes in red
- different colours need a process of re-focusing, so spectrally extreme colours (e.g. blue and red) should not be placed together.
- warm colours (reds and yellows) are seen as “coming towards” and cold colours as “going away”
- colour blindness (esp. red-green)
- users with black and white displays

- no colours is better than too much colours (**Las Vegas effect**)
- It is not only a physical issue! Different cultures attribute different meaning to colours: e.g. red can be associated with hot/danger/happiness/stop
- general appearance of the screen: do not put too many items
- avoid changing the position that an object occupies on the screen with no reason
- fonts:

Try not to mix too many fonts

Try not to mix too many fonts

Try not to mix too many fonts

`Try not to mix too many fonts`

Try not to mix too many fonts

Try not to mix too many fonts

Hearing

- hearing is, like touch, a response to pressure caused by sound waves reaching the ears
- sound waves vary in:

  amplitude: the height of the wave crest

  wavelength: the distance between each wave crest

  frequency: the number of waves per second
- these, objective, physical dimensions are translated by the brain into:

  loudness: a sound appears louder as amplitude increase. Loudness is measured in *decibels*. The threshold of hearing is set as 0 decibels (20 decibels is a whisper, 100 is shouting, 160 a loud rock band, 180 a spacecraft launching)

  pitch: it increases with the increase of frequency. Pitch is measured in *hertz*. Most people can detect sound in the frequency range 20 to 20,000 Hz, but hearing is most sensitive in the range 1000 to 4000.

Alerts: how to get user's attention

Visual alert	Sound alert
Information is long and complex	Information is short and simple
The information will be referred to later	The information will not be referred to later
User attention is not needed immediately	An immediate response is needed
The user's aural system is already overburdened	The visual system is already overburdened
The user is not moving	The user is moving from place to place
A verbal response is not needed	A verbal response is needed
Illumination is good	Poor illumination makes vision unreliable

Understanding the user: Mental capabilities - Memory

- memory is an important factor to consider for effective HCI: users should not be required to remind of lots of meaningless pieces of information, but also human potentials should be maximized
- there is not yet general agreement on how human memory operates, but it is useful to describe it as consisting of:
  - long term memory
  - working memory, or short term memory
  - sensory memory

Long term memory (LTM)

- It's the area of memory where information is stored and can be retrieved over very long period of time
- it's probably infinite
- it's associative: time is needed to retrieve information
- the state of "forgetting" might be seen as the inability to find "the right link"
- there is no complete control over what will be stored
- items in LTM have to be brought into Working Memory before they can be used: this process is called *activation*
- as for any kind of complex system, recalling from LTM will slow down the activity of the user

Some types of LTM

Episodic Memory: involves memory for events. It records individual's day-to-day experiences. Extremely high capacity: new memories are formed every few seconds and many of those persist in the memory for years.
It is concerned with *remembering*: it is oriented towards the past (retrieving information involves remembering past events).

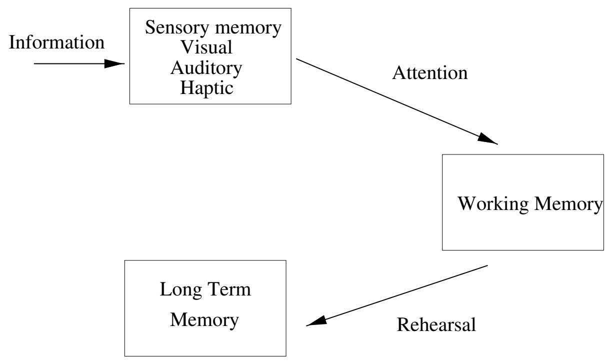
Semantic Memory: it is concerned with *knowing*, and involves knowledge about the world: facts, rules and general knowledge. It is present-oriented: utilization (retrieval) of information usually occurs for the purpose of whatever one is doing now.

Short Term, or Working Memory

- originally, psychologists have identified Short Term Memory as an area of memory that was able to hold limited information for short time, and this information would be lost unless constantly refreshed
- modern psychology developed an alternative view of short term memory, suggesting that it is an area where current processing takes place
- the adjective ”working” emphasizes the processing of information and not its particular content
- we use WM when we listen to human speech, to hold the segments of sentences ”on-line”, carry forward, in real time, the subject of a sentence and associate it with verbs and objects in order to comprehend the sense and meaning of sentences
- we also use WM when we perform a mental arithmetic problem, recall a phone number, plan a hand of bridge or chess move, or follow a verbal instruction

Sensory memory

- it is the area of conscious memory that deals with information from the senses
- apparently, this information is kept separate from WM (e.g. you might hear a sound before actually processing the information that the sound conveys)
- some sensory memories are more durable and effective than others: e.g. in humans, aural memory is better than visual memory, and memory for taste and smell is even more elusive (but it’s not the same for other animals!)



Chunking

- Experiments have shown that the capacity of short term memory is 7 plus or minus 2 *chunks* of information
- if pieces of information can be grouped together, so that they form an item, more can be remembered. Compare for instance:

  01517943693   0151 - 794 - 3693

  G G N N T I H I A U   H U N G A T I N G
- it is then advisable not to present more than 5-9 items to the users, unless chunking is possible
- but consider that chunking is subjective!

Primacy and Recency effects

barrier
firearms
scarf
newspaper
sea-shell
tomato
apologies
table
elephant
plant
chemist
identity
percolator
saucer
tiles
directory