Human Computer Interfacing
CSE - 476

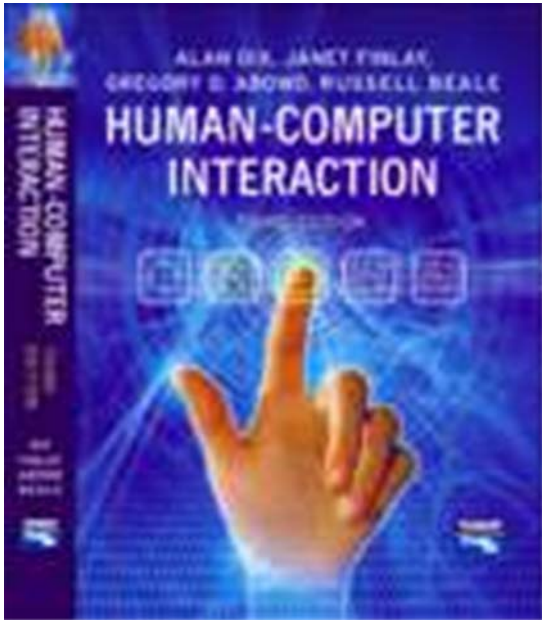
Introduction

Lecture # 1

Imran Siddiqi
imran.siddiqi@gmail.com

Course Information

- BOOK
  - ***Human-Computer Interaction***, Third Edition, **by Alan Dix, Janet Finlay, Gregory Abowd, and Russell Beale**. Prentice Hall.



What the class will look like

Lectures

Readings

Term Project

Quizzes

Assignments

Lecture Contents

- Introduction
- Human
  - Input/Output Channels
  - Human Memory
  - Thinking

User Interface – Hall of Shame

User Interface – Hall of Shame

- Presents a number of templates
- Prints custom award certificates

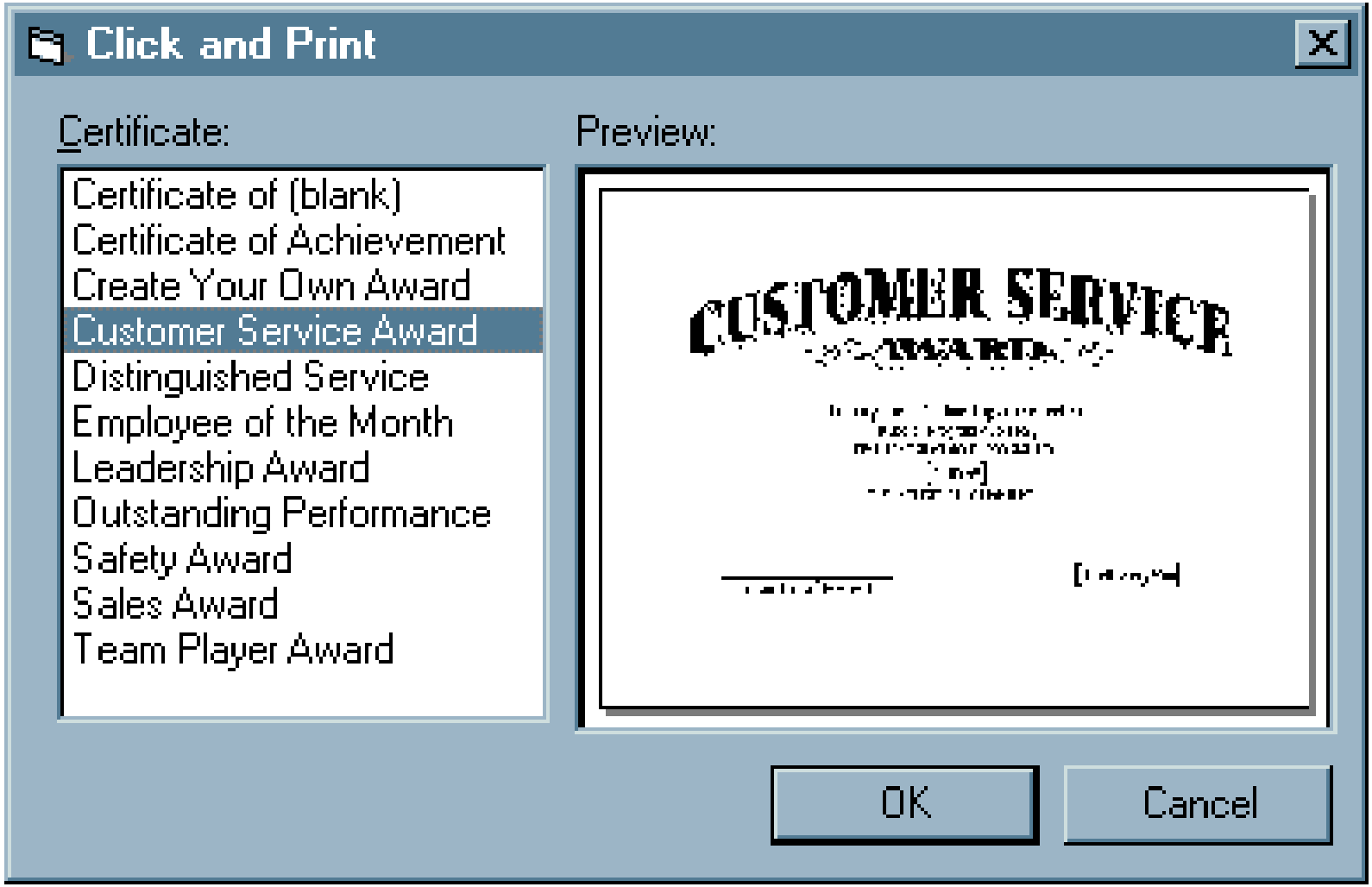
- Good points about the Interface?
  - Graphical – Mouse Driven
  - No complicated commands to remember
  - User gets a preview of the certificate

User Interface – Hall of Shame

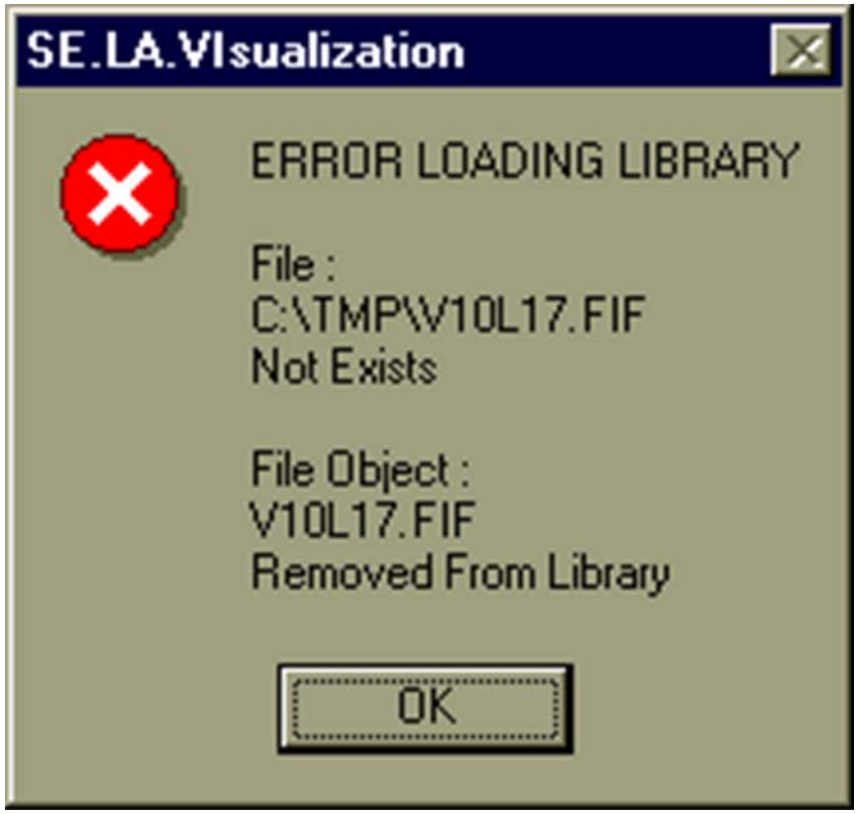
- Why isn't it usable?
  - Long help message for a simple '*selection*' task
    - *Because the interface is bizzare*
  - Moving the scroll bar changes the template
    - How many templates?
    - How are they sorted?
    - How much to move the bar to select the next template?
    - Frequent users: How to find a template already used

How would you redesign?

The Interface Redesigned



The Error Dialog



- We see it all the time
- What's good about the design of this error box?
  - The user knows there is an error
- What's poor about the design of this error box?
  - Not enough information
  - The user does not know how to resolve the error (instructions or contact info)

What is HCI

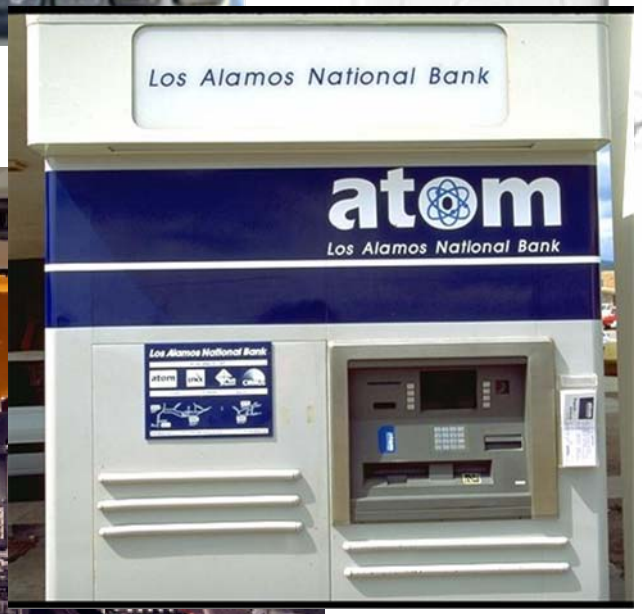
- Human–computer interaction (HCI) is the study of interaction between people (users) and computers.

- HCI is a discipline concerned with the *design*, *evaluation* and *implementation* of interactive computing systems for human use.

- Human and a computer system interact to perform a task?
  - task - write document, calculate budget, solve equation, learn about Bosnia, drive home, make a reservation, land a plane...

Interfaces in the Real World

- Not just computers!
  - VCR
  - ATM
  - Phone
  - Copier
  - Car
  - Plane cockpit
  - ……..



Why HCI is important

- HCI is not just '*how big should I make buttons*' or '*how to layout menu choices*'
- It can affect:
  - Effectiveness
  - Productivity
  - Morale
  - Safety
- Example: A car with poor HCI

The Human

- User – Information Processing System
- Information
  - Comes in (Input)
  - Is stored (Memory)
  - Is processed (Processing)
  - Is passed out (Output)

The Human

- Information i/o …
  - visual, auditory, haptic (touch), movement
- Information stored in memory
  - sensory, short-term, long-term
- Information processed and applied
  - reasoning, problem solving, skill, error
- Emotion influences human capabilities
- Each person is different

Lecture Contents

- Introduction
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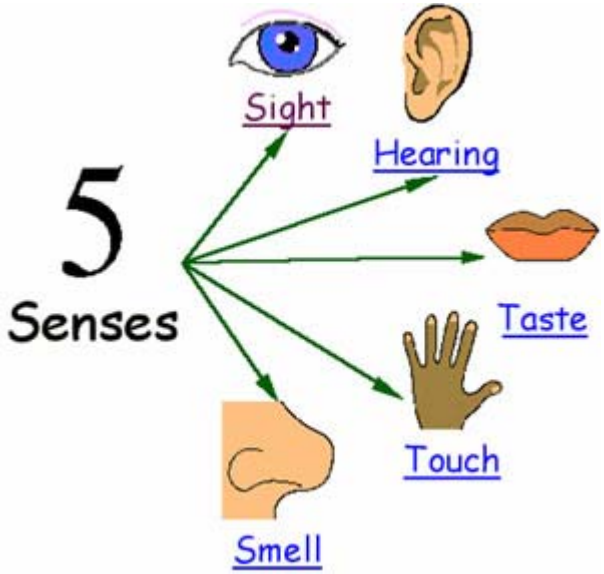
  - Human Memory
  - Thinking

Input/Output Channels

- Input – Output
  - Person interacts with outside world through information being received and sent
- User's output = Computer's Input (vice versa)
- Human
  - Input : Senses
  - Output: Effectors

Input/Output Channels

- Input – Five senses
  - Sight/Vision
  - Hearing
  - Touch
  - Taste
  - Smell



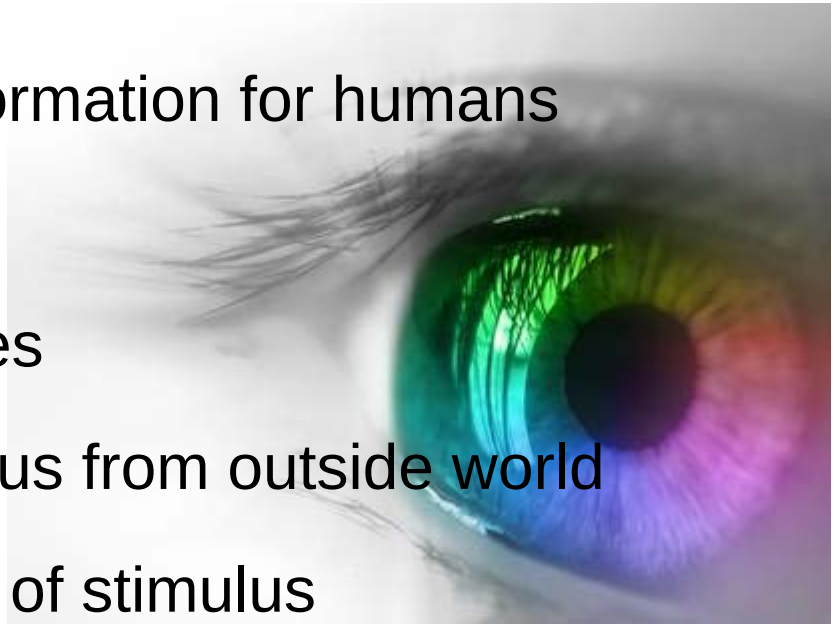
- Output – Effectors
  - Limbs
  - Fingers (primary role, typing or mouse control)
  - Eyes
  - Head & Body

Example

- Computer with keyboard and mouse
- Application: GUI, Menus & Icons
- Information Received
  - Sight
  - Ears?
  - Touch?
- Information Sent
  - Hands: Keyboard, mouse

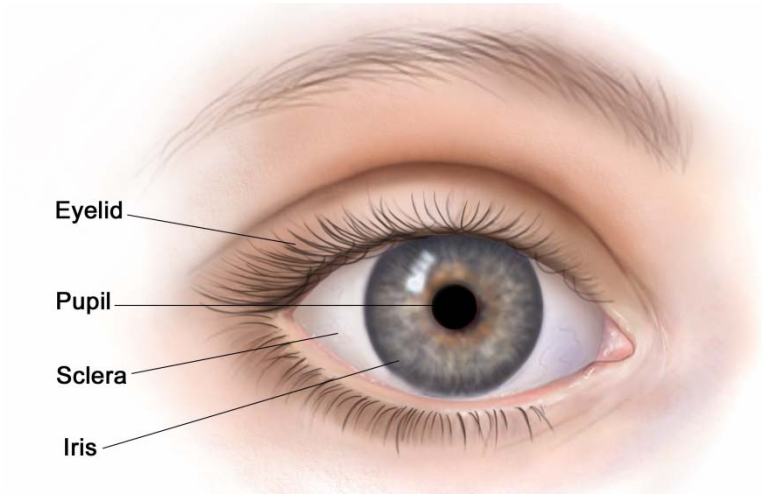
Vision

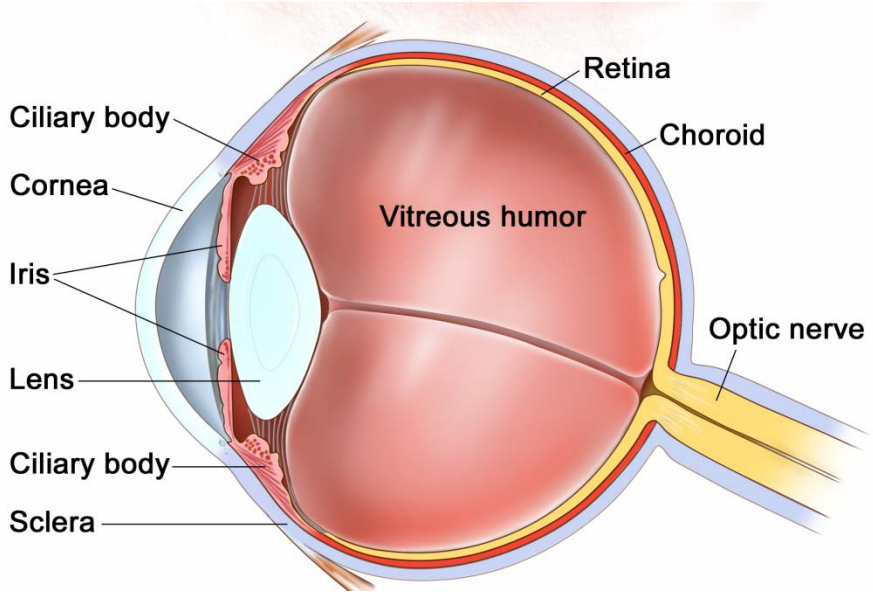
- Vision is primary source of information for humans



- Visual Perception – Two Stages
  - Physical reception of stimulus from outside world
  - Processing & Interpretation of stimulus

The Eye

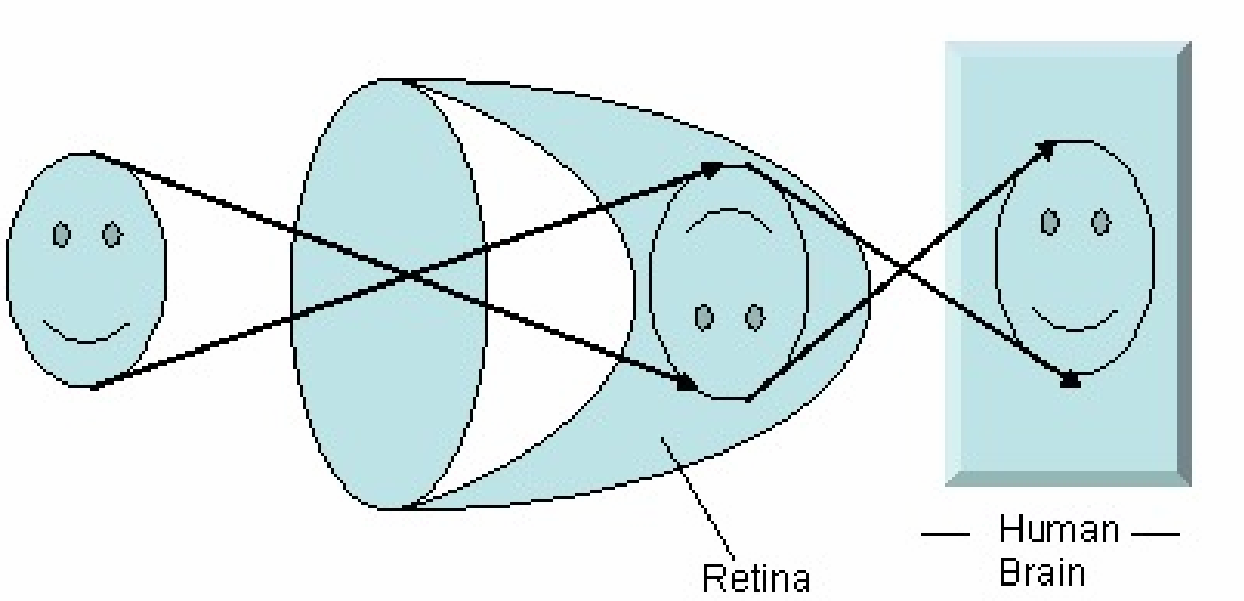

Eyelid
Pupil
Sclera
Iris


Retina
Ciliary body
Choroid
Cornea
Vitreous humor
Iris
Optic nerve
Lens
Ciliary body
Sclera

The Eye – Physical Reception

- Eye is a mechanism for receiving light and transforming it into electrical energy
- Light is reflected from objects
- Images are focused upside-down on retina
- Retina contains photoreceptors
  - Rods: Highly sensitive to light
  - Cones: Color Vision

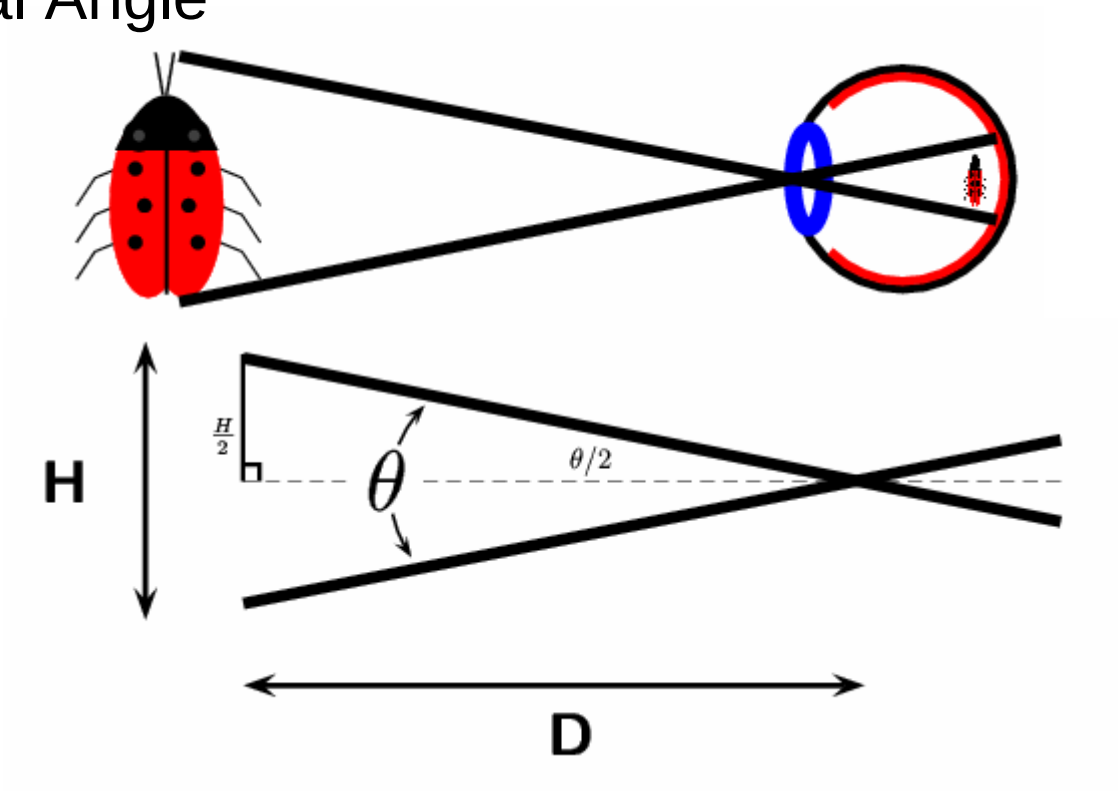
Interpreting the Signal



- Size and depth
  - Visual angle indicates how much of view object occupies
  - Relates to size and distance from eye

Interpreting the Signal

- Visual Angle



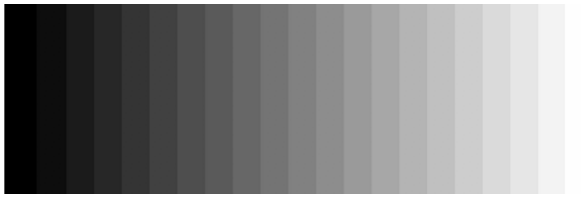
$$\theta = 2 \times arctan\left(\frac{H}{2D}\right)$$

Interpreting the Signal

- Size and depth
  - Familiar objects perceived as constant size
    - Size constancy: an object appears to maintain a constant size even though its retinal image size changes with distance
  - Cues like overlapping help perception of depth

Interpreting the Signal

- Brightness
  - Reaction to levels of light
  - Affected by luminance of object
  - Contrast: luminance of object & its background



- Colour
  - Made up of hue, saturation, value
  - Cones sensitive to colour wavelengths
    - Red, Green, Blue
  - 8% males and 1% females colour blind

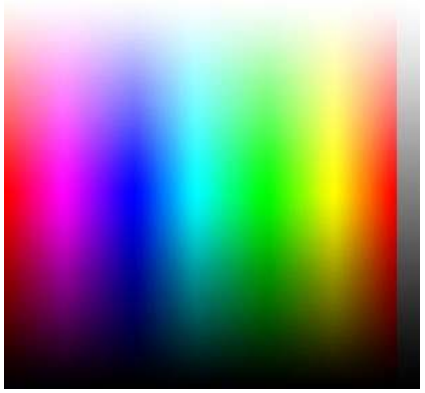
Interpreting the Signal - Colour

- Hue

  - Hue is what most people think of when we say *color*
  - Hue is the name of a distinct color of the spectrum, It is the particular wavelength frequency

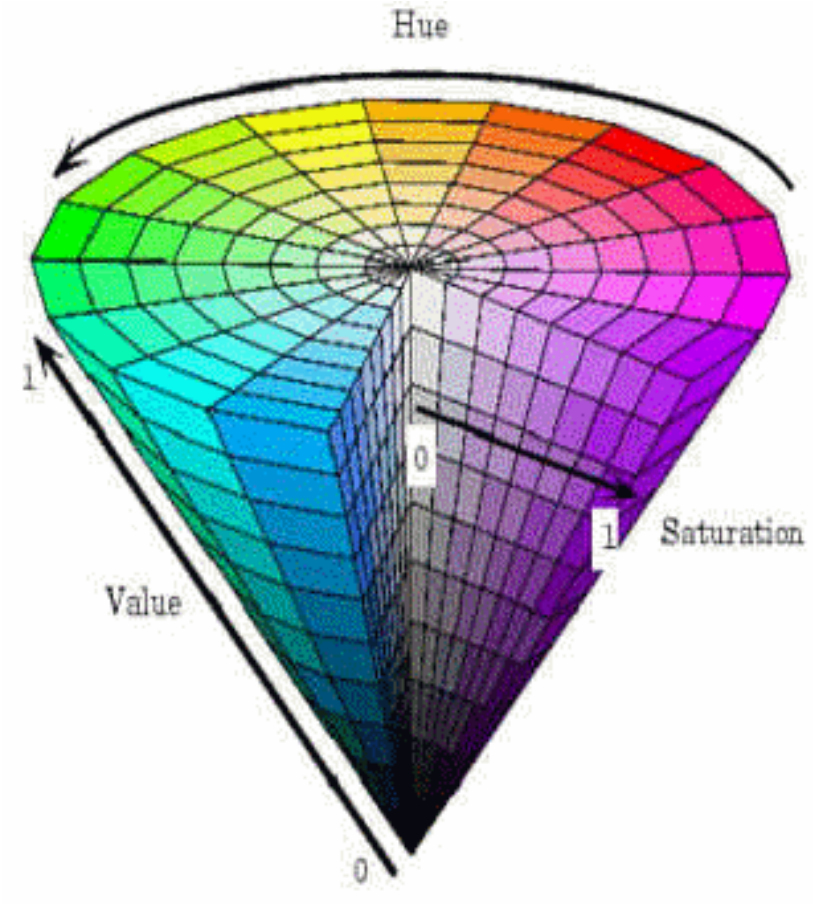
- Saturation
  - Saturation is the *purity* of a colour

- Value (Intensity, Brightness, Lightness)
  - Refers to the intensity of light present. When light is at its fullest intensity, colors will become bright
  - Unlike saturation, there isn't necessarily *less* of the color – it is just not as intense



Interpreting the Signal - Colour

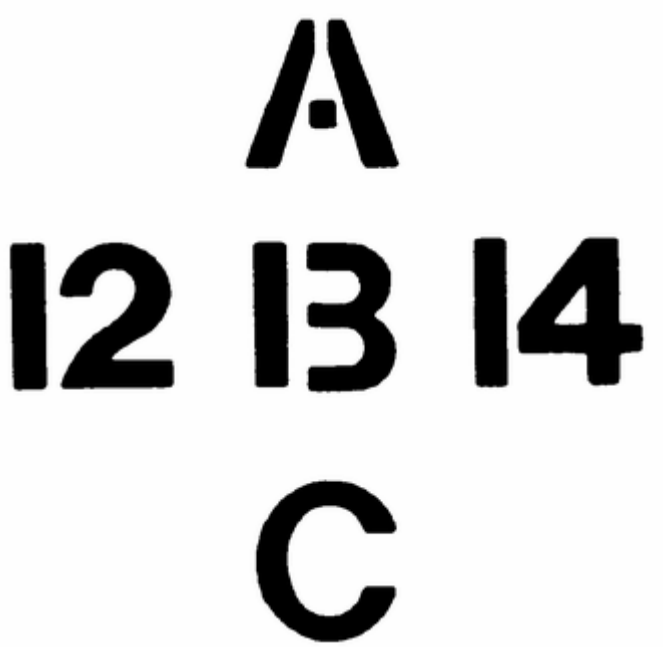
- HSV



Interpreting the Signal

- Ambiguity

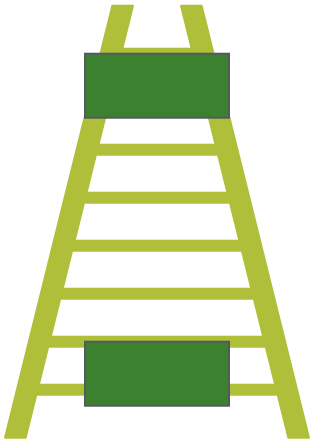
B or 13 ???



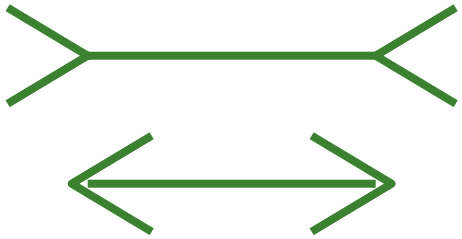
- Context is used to resolve ambiguity
  - Interpret & exploit the expectation

Interpreting the Signal

- Optical Illusions



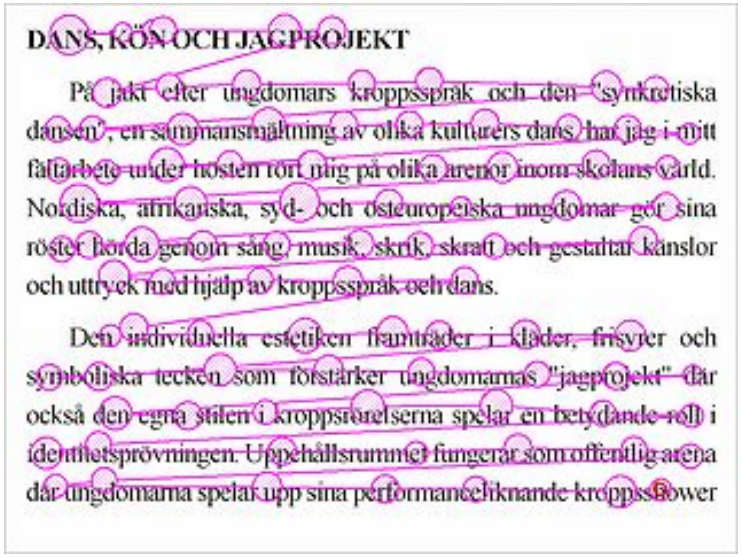
the Ponzo illusion



the Muller Lyer illusion

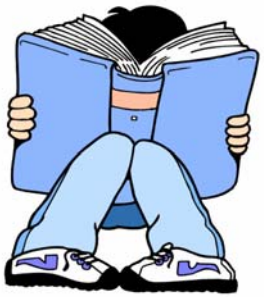
Reading

- Several stages:
  - Visual pattern of a word perceived
  - Decoded using internal representation of language
  - Interpreted using knowledge of syntax, semantics
- Reading involves saccades* and fixations



*Jerky movements of eye

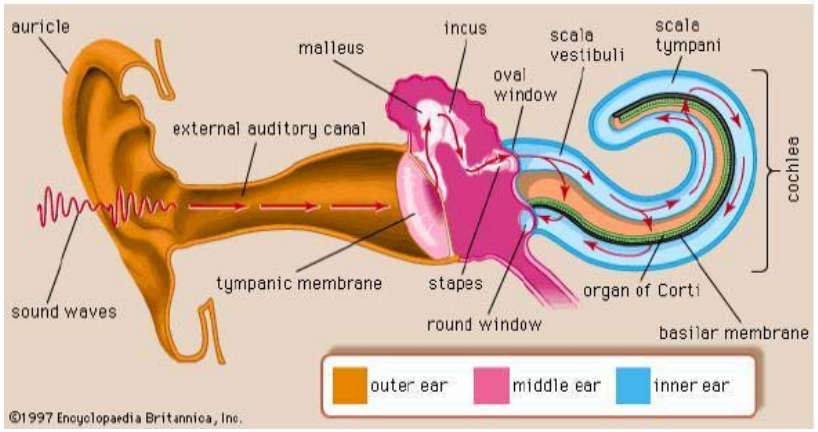
Reading



- Perception occurs during fixations
  - 94% of the elapsed time
- Regression
  - Forwards & Backward movements of eye over text
- Word shape is important to recognition
- Reading speed
  - Legibility: font size, line length etc.

Hearing

- Provides information about environment:
  - Distances, directions, objects etc.
- Physical apparatus:
  - Outer ear
  - Middle ear
  - Inner ear



- Sound
  - Pitch – Sound frequency
  - Loudness – Amplitude
  - Timbre – Type or quality

Hearing

- Humans can hear frequencies from 20Hz to 15kHz
- Auditory system filters sounds
  - Can attend to sounds over background noise
  - For example, the cocktail party phenomenon

Touch

- Provides important feedback about environment
- May be key sense for someone who is visually impaired
- Stimulus received via receptors in the skin:
  - Thermoreceptors – heat and cold
  - Nociceptors – pain
  - Mechanoreceptors – pressure
- Some areas more sensitive than others e.g. fingers
- Question: Ecommerce (CDs & Books vs. Clothes)

Movement

- Fitt's Law
  - Describes the time taken to hit a screen target

$$\text{Movement Time} = a + b \log_2(D/S + 1)$$

where:
a and *b* are empirically determined constants
D is Distance from target centre
S is Size of target

Important: D & S are calculated along the axis of motion

Movement

- Fitt's Law

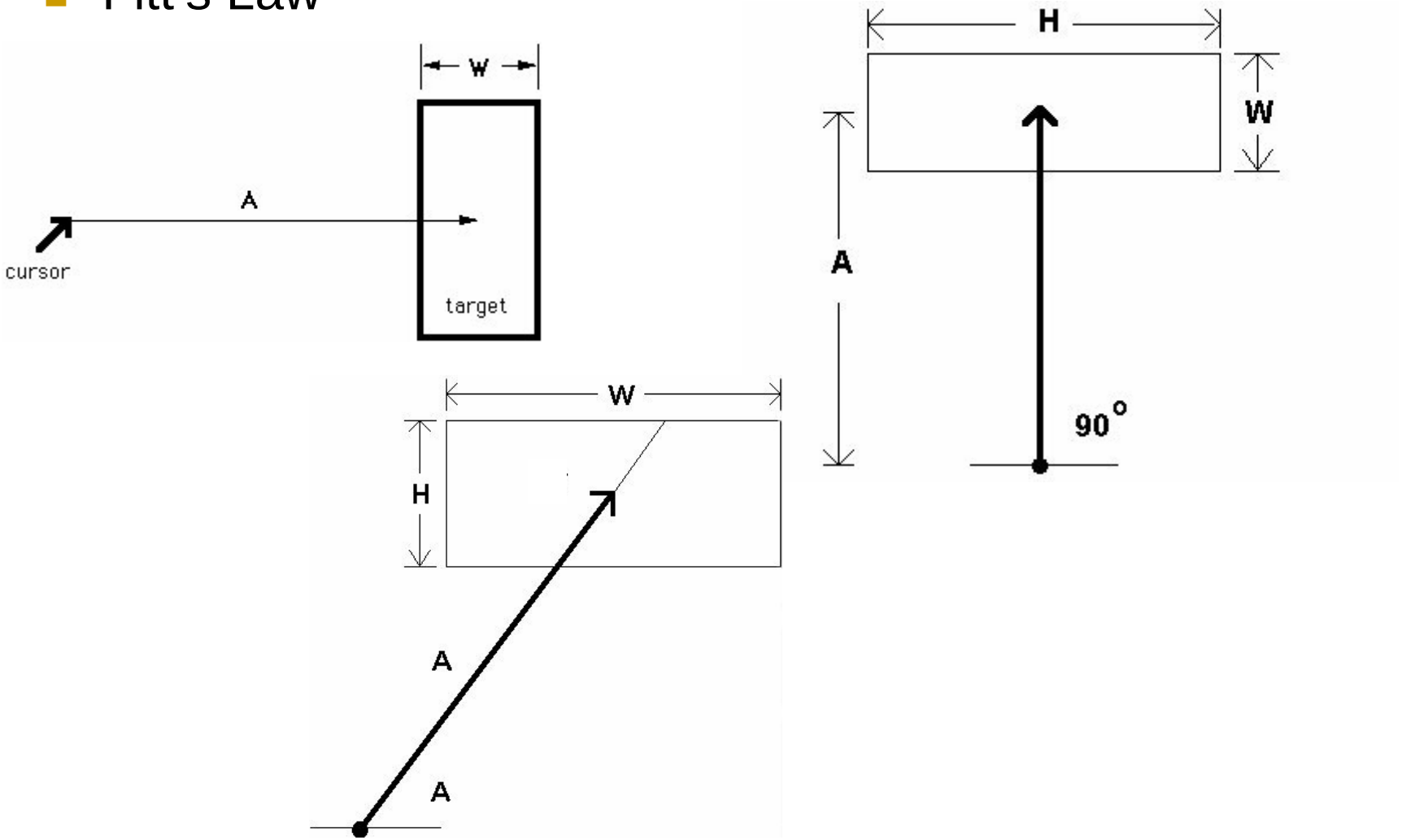
$$\text{Movement Time} = a + b \log_2(D/S + 1)$$

Index of Difficulty

=> Targets as large as possible
=> Distances as small as possible

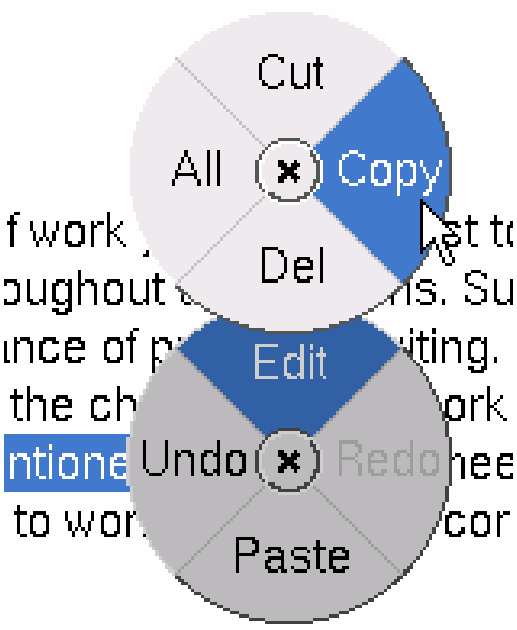
Movement

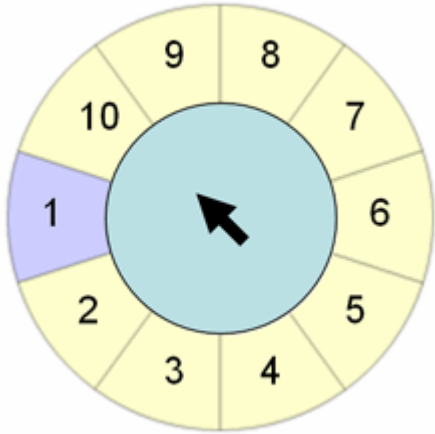
- Fitt's Law



Movement

- Pie-chart shaped menus
  - All options are equidistant (As opposed to lists)
  - Increased used of screen estate





References

- Human Computer Interaction by Dix et al.
- User Interface Design and Implementation, Prof. Robert Miller - MIT
- User Interface Hall of Fame/Shame