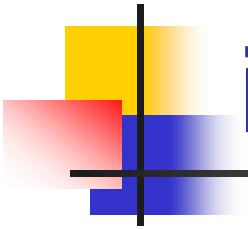
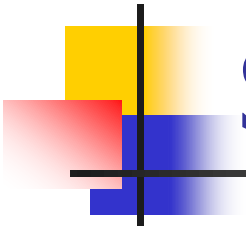
Design of HCI: Who is involved?

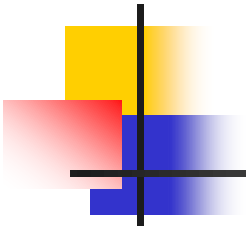


- Computer scientists
  - Software designers
  - Hardware developers
- Psychologists
- Graphic designers
- Technical writers
- Anthropologists/Sociologists



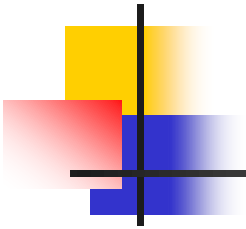
Software Designers

- Implementation of the interface
- Develop more effective ways to organize and present information on the interface.
- Use different modalities to facilitate interaction
  - Sound
  - Animation
  - Video



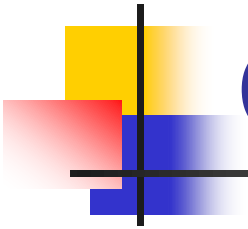
Hardware Developers

- Design of novel keyboard and pointing devices.
- Higher resolution color displays
- New devices for multimodal interaction
  - Speech input and output
  - Gestural input
  - Tactile or force-feedback output
  - Touchscreen
  - Stylus and graphics tablets.



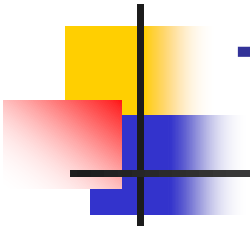
Psychologists

- Develop perceptual, cognitive and motor theories.
- Construct models of human performance



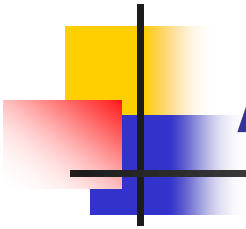
Graphic Designers

- Engaged in
  - Visual layout
  - Color selection
  - Animation



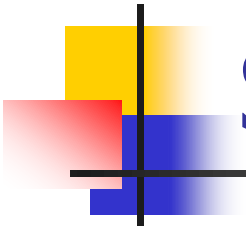
Technical writers

- Create
  - Online tutorials
  - Reference manuals
  - Demonstrations



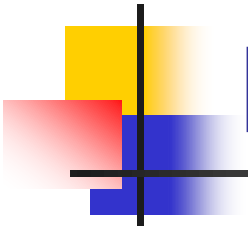
Anthropologists/Sociologists

- Organizational impact
- Distributed teamwork
- Computer-supported cooperation strategies



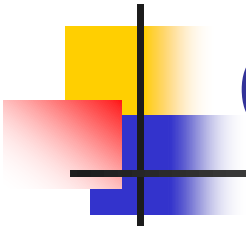
Specific HCI Job Titles

- Interaction designers
  - People involved in the design of all the interactive aspects of a product.
- Web designers
  - People who create the visual design of web sites, such as layouts.
- Usability engineers
  - People who focus on evaluating products using usability principles.



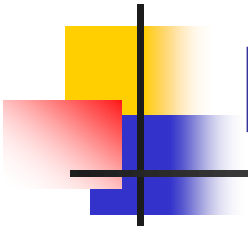
Design Goals

- System Engineering
- Interface Design



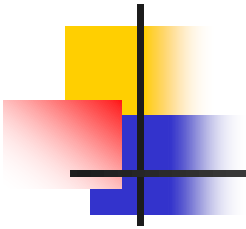
Goals of System Engineering

- Proper functionality
- Achieve required reliability
- Foster design standardization
- Schedules and budgets



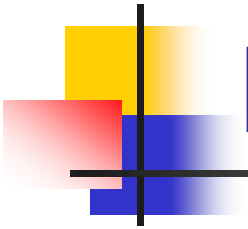
Proper functionality

- What tasks need to be carried out ?
- Task analysis is important
  - Inadequate functionality will frustrate users.
  - Excessive functionality will confuse users.



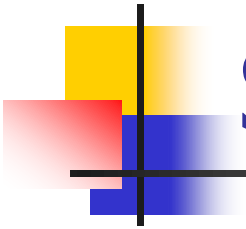
Reliability

- Ensure high availability for the system.
- Ensure privacy, security and data integrity.



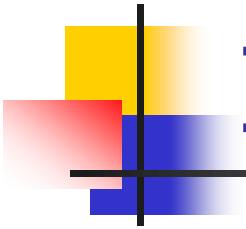
Design Standardization

- Standardization
- Integration
- Consistency
- Portability



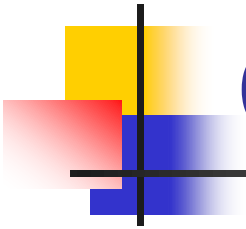
Standardization

- Common user-interface features across multiple applications.
  - Microsoft Windows
  - Mac OS



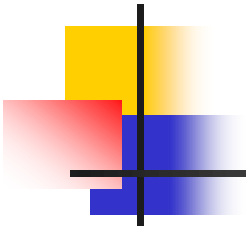
Integration

- To allow different application packages and software tools to work together.
- Example
  - Pipelining in Unix
    - `ls -l|grep program.c`
  - Cut and paste of data across different applications in Windows.



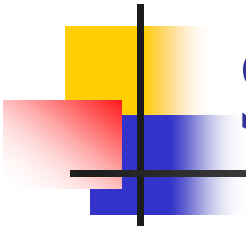
Consistency

- Similar command sequence results in similar actions.
- Strong determinant of system success.



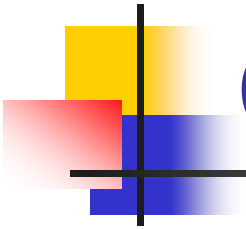
Portability

- Potential to share data and applications across different platforms.
- Have to contend with
  - Different hardware architectures
  - Different operating systems
  - Different data formats
- Example: Java Virtual Machine (JVM)



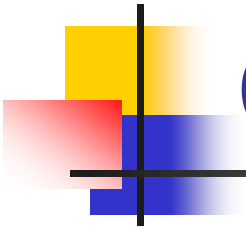
Schedules and Budgets

- Important to complete projects
  - On schedule (time constraint)
  - Within budget (resource constraint)
- Delayed delivery or cost overruns will lead to
  - Customer dissatisfaction
  - Reduced profit



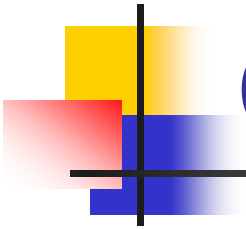
Goals of User-Interface Design

- Time to learn
- Speed of performance
- Rate of errors by users
- Retention over time
- Subjective satisfaction



Goals of UI Design (cont'd)

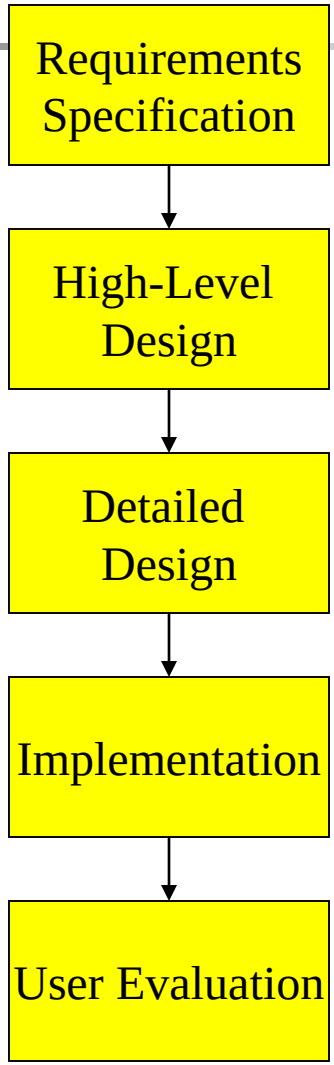
- Time to learn
  - How long does it take to learn the commands ?
- Speed of performance
  - How long does it take to carry out a task ?
- Rate of errors by users
  - How many errors do users make ?
  - What kinds of errors do users make ?



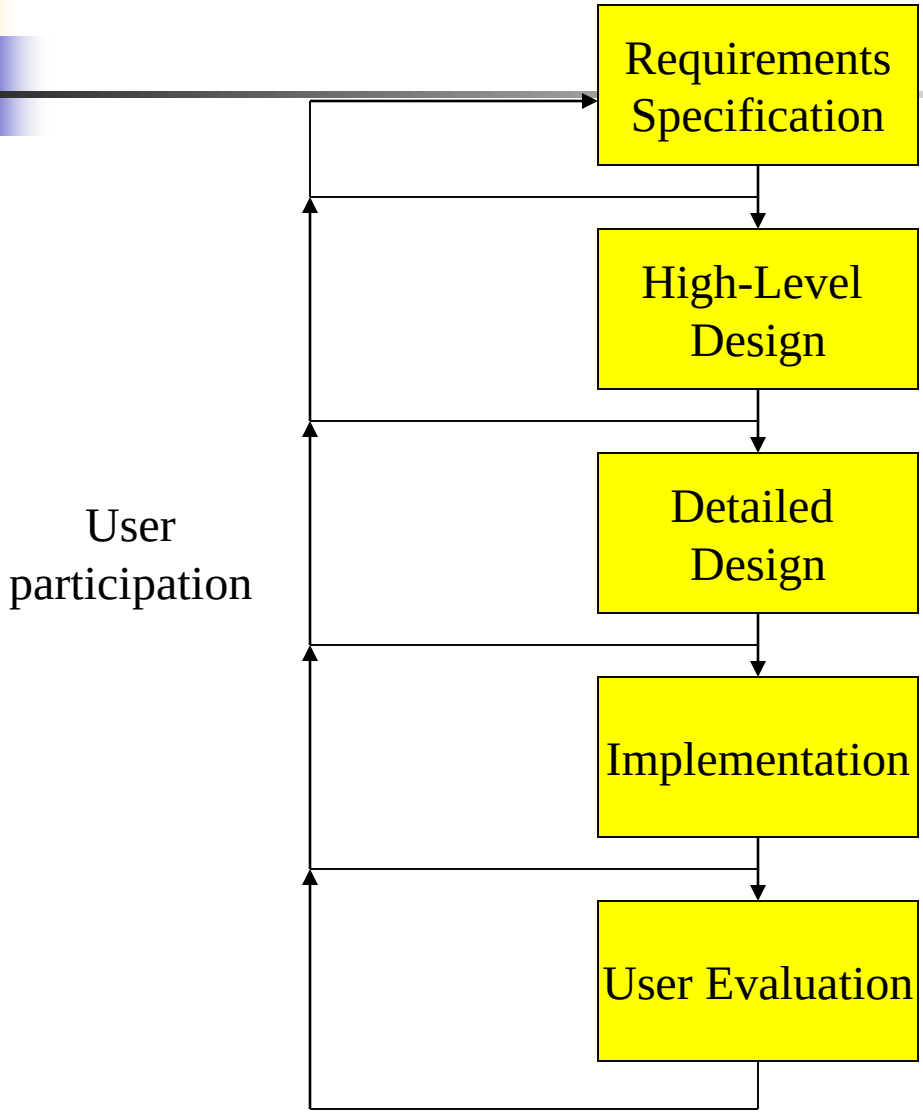
Goals of UI Design (cont'd)

- Retention over time
  - How well do users remember their knowledge ?
  - Linked closely to time to learn and frequency of use.
- Subjective satisfaction
  - How much did users like using the system ?

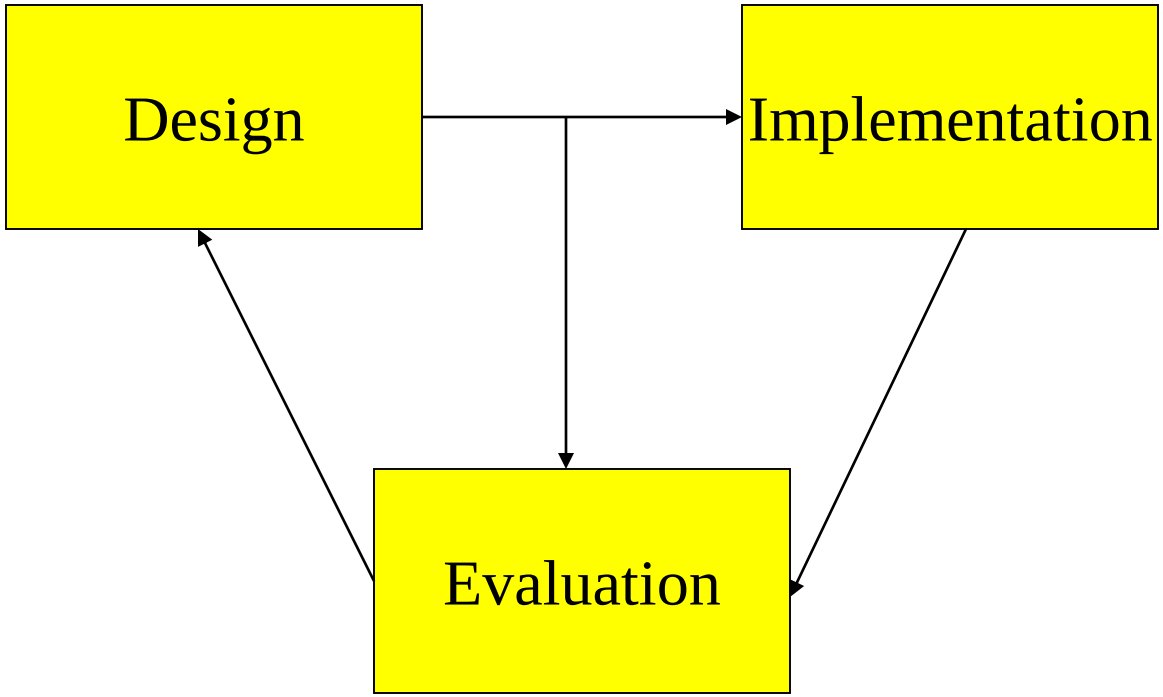
UI Design Process

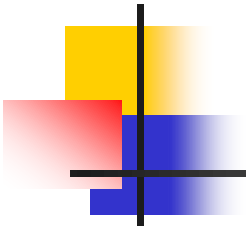


Improved UI Design Process



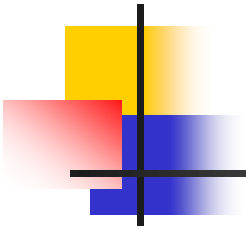
UI Design: Another Viewpoint





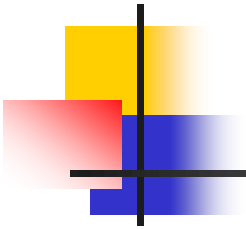
Design

- Includes the following stages
  - Requirements specification
  - High-level design
  - Detailed design
- Requires the adoption of a set of principles and guidelines.



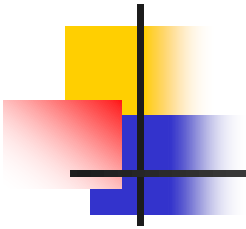
Prototyping

- Build prototypes using the suitable prototyping tool
  - Pen and paper
  - Presentation package (e.g. Powerpoint)
  - Interface builder (e.g. Visual Basic, Java)



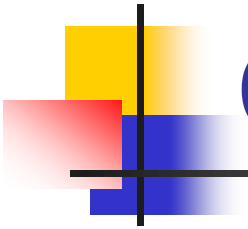
Prototyping (cont'd)

- Advantages of prototyping
  - Low cost
  - Allow users to try out design alternatives.
  - Allow designers to discover potentially serious problems before it is too late.



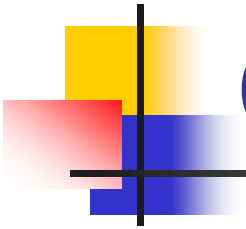
Evaluation

- Evaluation approaches
  - Think aloud
  - Questionnaires
  - Interviews
  - Formal usability experiments



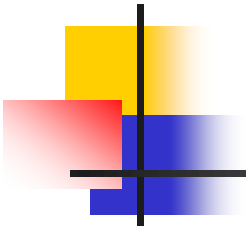
Case Study: ActiveAd

- An ActiveAd analyzes the contents of a web page to identify some key terms.
- A relevant advert is then displayed based on these information.
- These ads are clickable and directly link to the company's website.



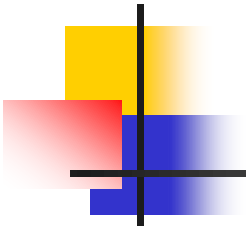
Case Study: ActiveAd

- We focus on the re-design of an ActiveAd for the company Betabet.
- Betabet runs a portal website to allow the placing of bets via the Internet.
- The betting odds are displayed for various sporting events such as soccer match and horse racing.
- The specific odds to be displayed are determined by the webpage contents.



Requirements Specification

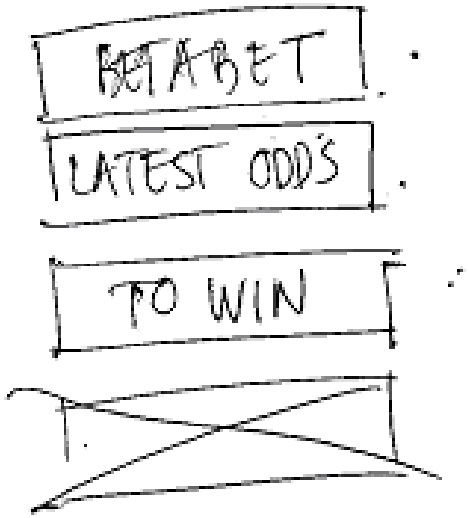
- The previous design needs improvement
  - The advert should show the winnings for a £10 pound bet based on the odds displayed.
  - The size of the advert is to be increased to 120×120 pixels.
  - More of the advert should be clickable.

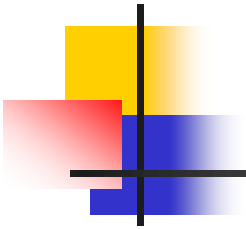


High Level Design

- Preliminary sketches of the interface are developed.
- The sketch indicates
  - where to put the main banner (at the top)
  - what the banner should contain (Betabet)
  - where and what to put in the other banner lines.

High Level Design

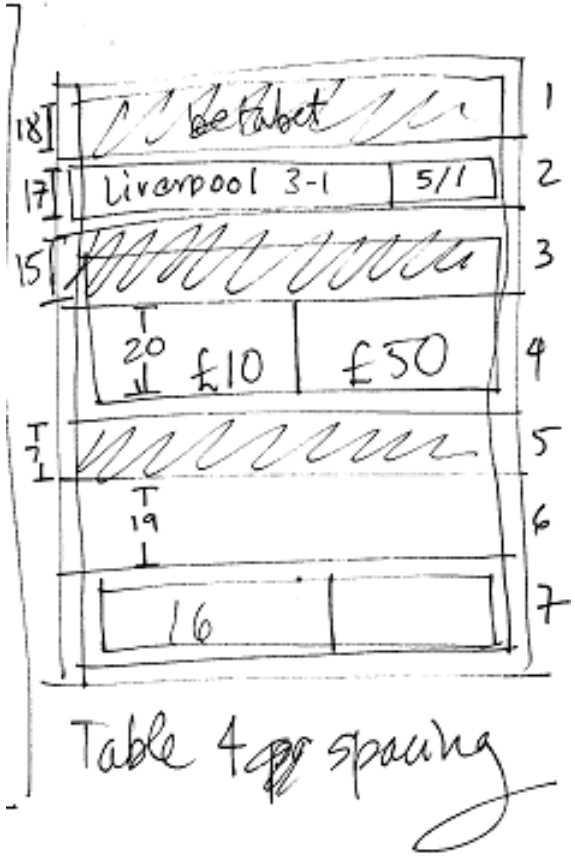




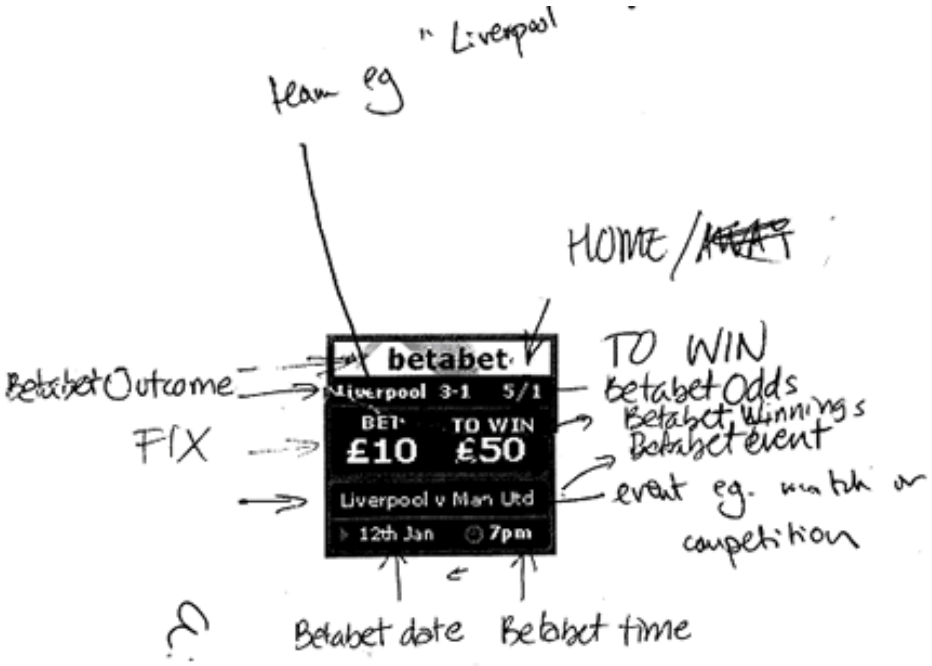
Detailed Design

- A more detailed sketch is developed which includes
  - the rows and their contents
  - the exact height of each row
- A Photoshop mockup is then produced to allow the designer to experiment with colors, typefaces, sizes and positioning.

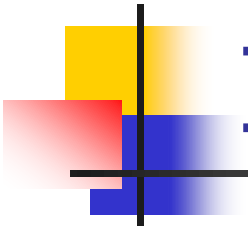
Detailed Design



Detailed Design



Photoshop mockup



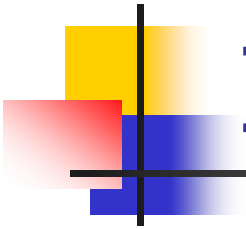
Implementation

- The executable version is then developed using Java.
- There are both static and animated elements.
- The static elements are developed first.
- The animated elements are superimposed on the background at a later stage.

Implementation

static background

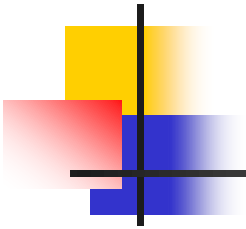
final ActiveAd



Implementation

- Initially, we directly specify the names of the teams and the odd values in the code to check its appearance.
- A webpage that contains an old advert is then taken offline.
- The new design is pasted on to the page to see how it looks.

Implementation

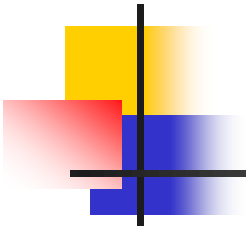


Evaluation

- Users are asked for their opinions and these will be adopted to further improve the interface.
- The interface is also tested on different platforms and different browsers to ensure that its appearance is the same.

Motivations of HCI Design

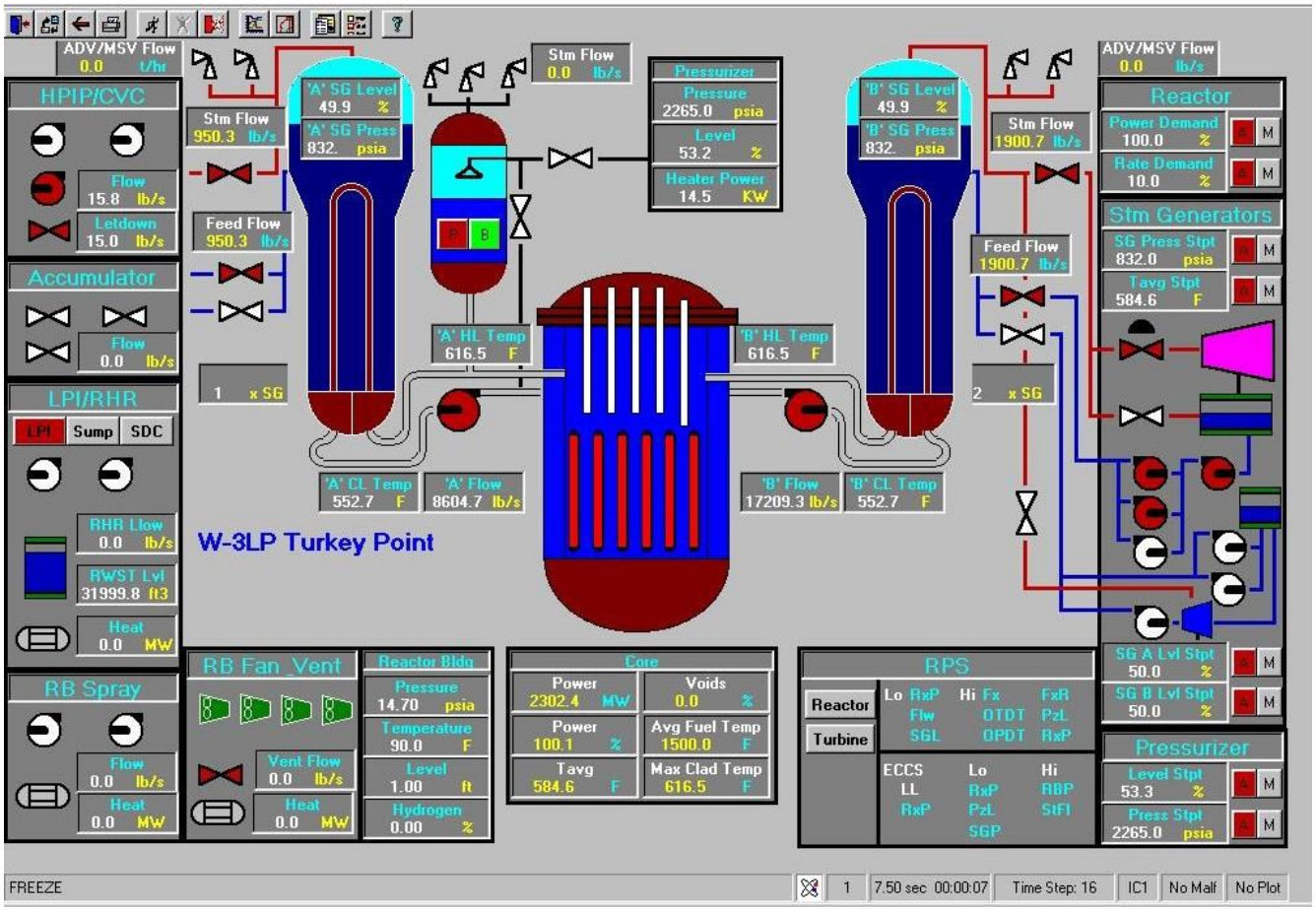
- Motivations of incorporating human factors are different for different systems:
  - Life-critical systems
  - Industrial and commercial users
  - Office, home and entertainment applications
  - Exploratory, creative and cooperative systems



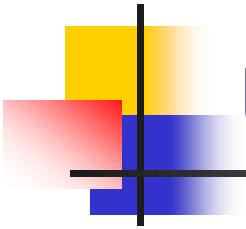
Life-critical systems

- Examples include software for controlling air traffic, nuclear reactors, etc.
- Expectations and requirements
  - High cost
  - High reliability and effectiveness
  - Lengthy training periods are acceptable for error-free performance.

Example:Nuclear Power Plant

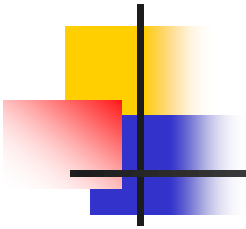


Industrial and commercial uses



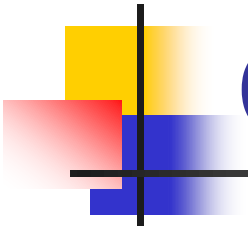
- Examples include banking, airline and hotel reservations, utility billing, etc.
- Expectations and requirements
  - Lower cost is preferred
  - Some sacrifice in reliability is acceptable
  - Ease of learning is important.

Office, Home and Entertainment Applications



- Examples include word processing, video games, educational packages, etc.
- Expectations and requirements
  - Ease of learning
  - Low cost
  - Low error rates
  - High subjective satisfaction

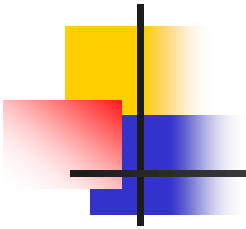
Explorative, Creative and Cooperative Systems



- Examples include electronic encyclopedias, World Wide Web browsing, etc.
- Expectations and requirements:
  - Provide direct manipulation of the world of action.
  - Familiar selections or gestures as inputs.
  - Immediate feedback and a new set of choices as outputs.

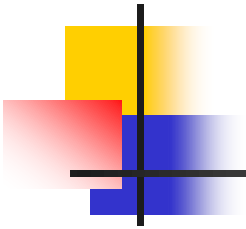
Exploratory System Example: Drug Design

Accommodation of Human Diversity



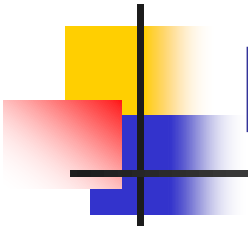
- Perceptual, cognitive and physical abilities
- Differences in user preferences
- Cultural and international diversity
- Users with disabilities
- Elderly users

Perceptual, Cognitive and Physical Abilities

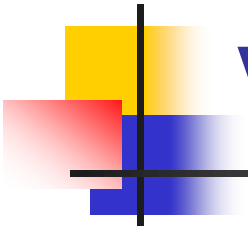


- No “average” user due to great diversity of human abilities.
- Multiple system versions or adjustment controls are required.
- Need to be aware of the ranges of different perceptual abilities
  - Vision (for display and visual interface design)
  - Hearing (for audible cues, speech I/O design)
  - Touch (for keyboard, touchscreen design)

Perceptual, Cognitive and Physical Abilities



- Need to understand
  - How users interpret sensory input (perceptual performance)
  - How users think (cognitive performance)
  - How users initiate actions (motor performance)

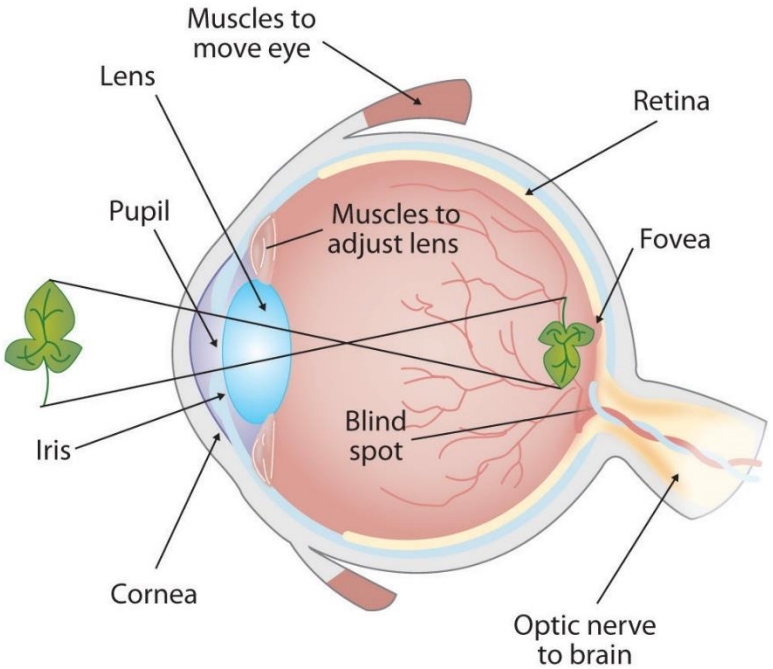


Vision

- Two stages in vision
  - Physical reception of stimulus
  - Processing and interpretation of stimulus

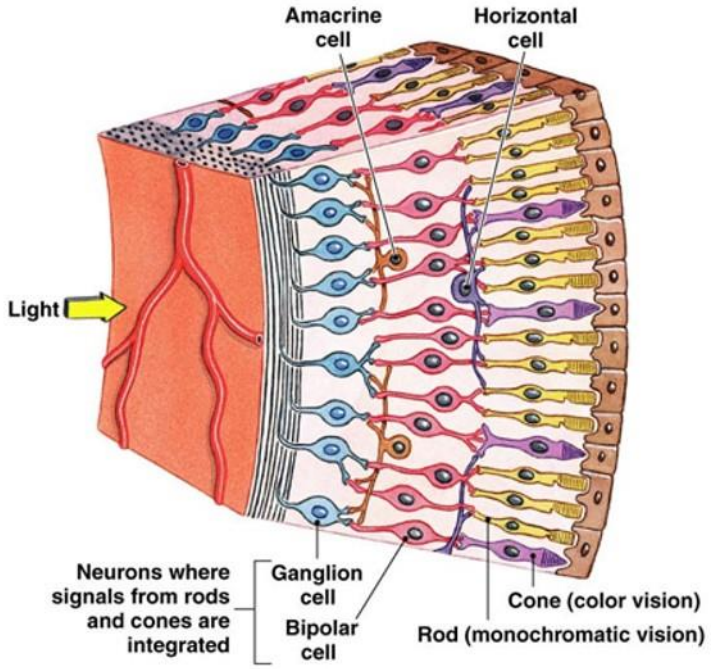
Physical Reception: The Eyes

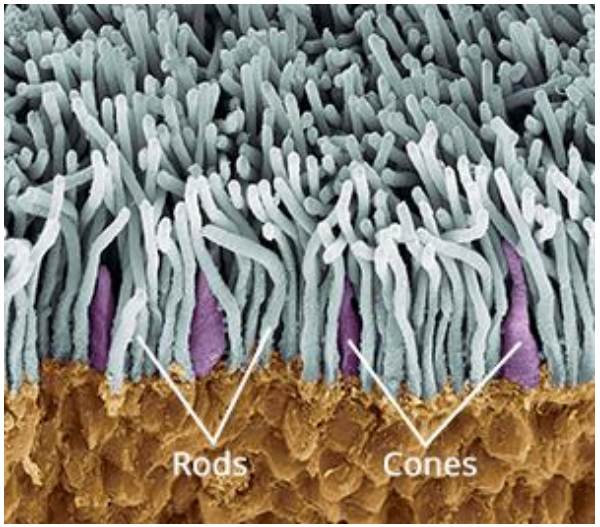
- The eyes receive light and transform it into electrical energy.
- Images are focused upside-down on retina.

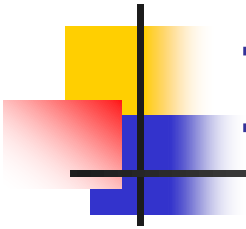


Physical Reception: The Eyes

- Retina contains
  - Rods for low light vision
  - Cones for color vision





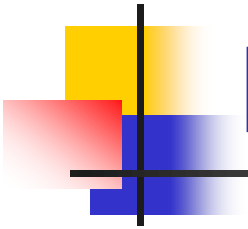


Interpretation of Visual Stimuli

- Brightness
  - Subjective reaction to levels of light
  - Affected by luminance of objects
  - Visual acuity increases with luminance but flicker also becomes more noticeable.

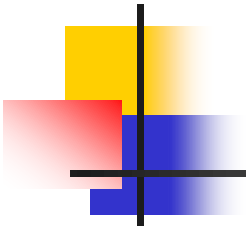
Interpretation of Visual Stimuli

- Color
  - Made up of hue, intensity, saturation.
  - Cones can resolve the different light wavelengths to provide the sensation of color.
  - Blue acuity is lower.
  - 8% males and 1% females are color blind.



Hearing

- Sound is characterized by
  - Pitch (sound frequency)
  - Loudness (amplitude)
  - Timbre (type or quality)



Hearing (cont'd)

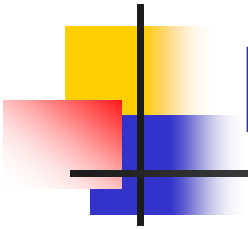
- Humans can hear frequencies from 20Hz to 15kHz.
- More difficult to distinguish high frequencies than low frequencies.
- Auditory system can attend to sounds over background noise (cocktail party effect).

Touch

- Provides important feedback about environment.
- The key sense for someone who is visually impaired.
- Main receptors
  - Thermoreceptors-heat and cold
  - Nociceptors-pain
  - Mechanoreceptors-pressure

Reaction Time

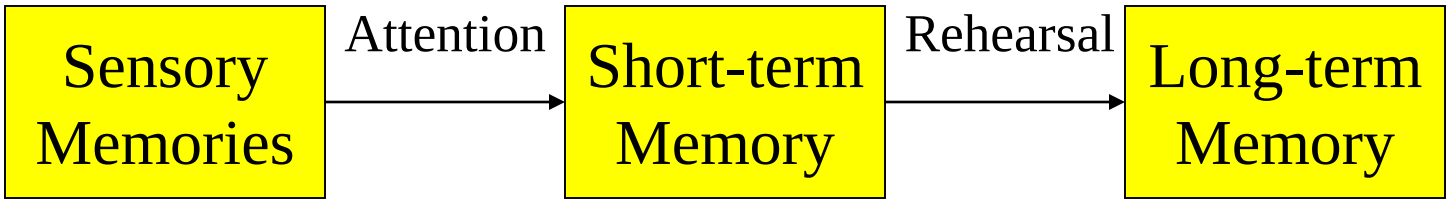
- Reaction time-dependent on stimulus type
  - Visual~200ms
  - Auditory~150ms
  - Pain~700ms
- Time taken to respond to stimulus: reaction time+movement time



Memory

- Three types of memory function
  - Sensory memories
    - Buffers for stimuli
  - Short-term or working memory
  - Long-term memory

Memory (cont'd)

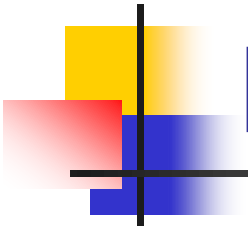


Short-term Memory (STM)

- Scratch-pad for temporary recall
  - Rapid access~70ms
  - Rapid decay~200ms
  - Limited capacity-4±1 chunks

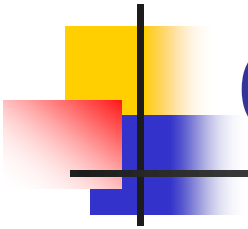
Can you remember these items ?

- 20267
- 2358665029456028 9
- LKJGL
- UOQPRTNGGNWQERT



Long-term memory (LTM)

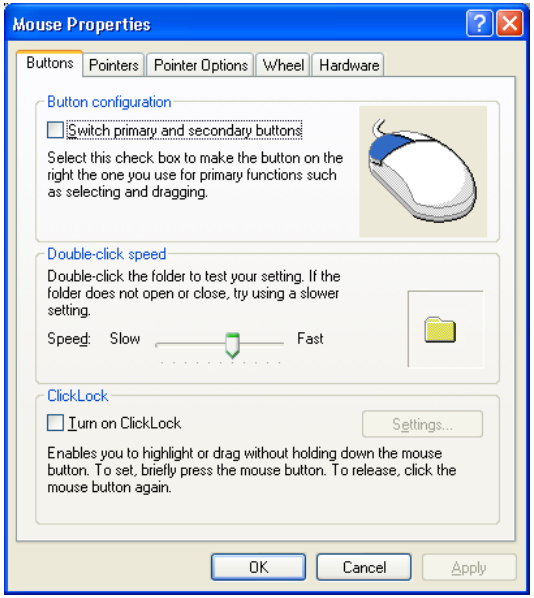
- Repository for our knowledge
  - Less rapid access ~ 0.1s
  - Slow decay
  - Large capacity

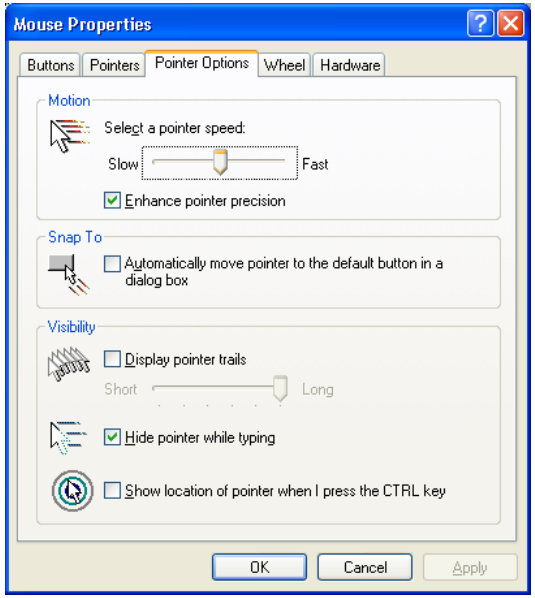


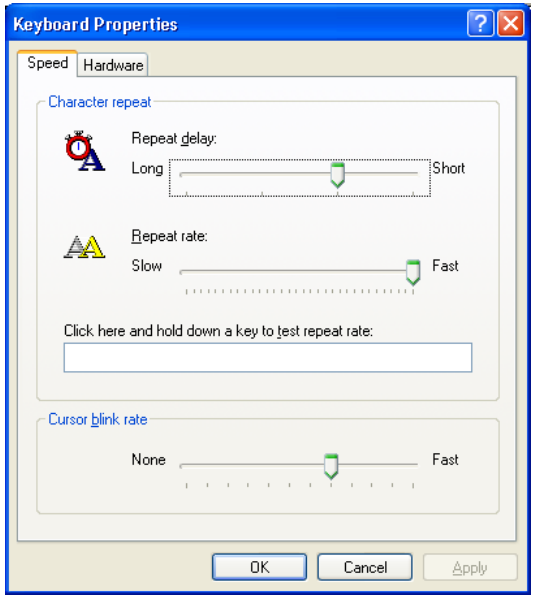
Other Characteristics

- We recognize things much better than being able to recall things
  - Rise of GUI over command-based interfaces.
- Better at remembering images than words
  - The use of icons rather than names.

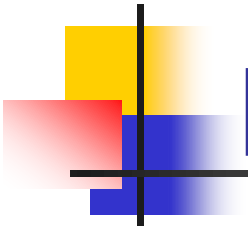
Accommodation of Different Abilities: Examples





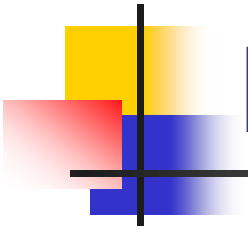


Differences in user preferences



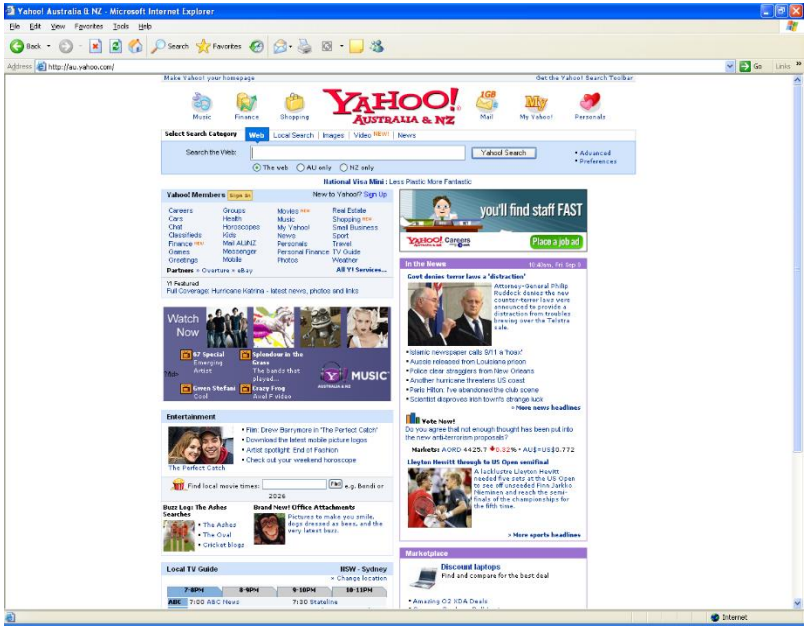
- Users have different preferences for interfaces
  - GUI vs command language
  - text vs speech input/output
- A clear understanding of different personality styles is required.

Cultural and International Diversity



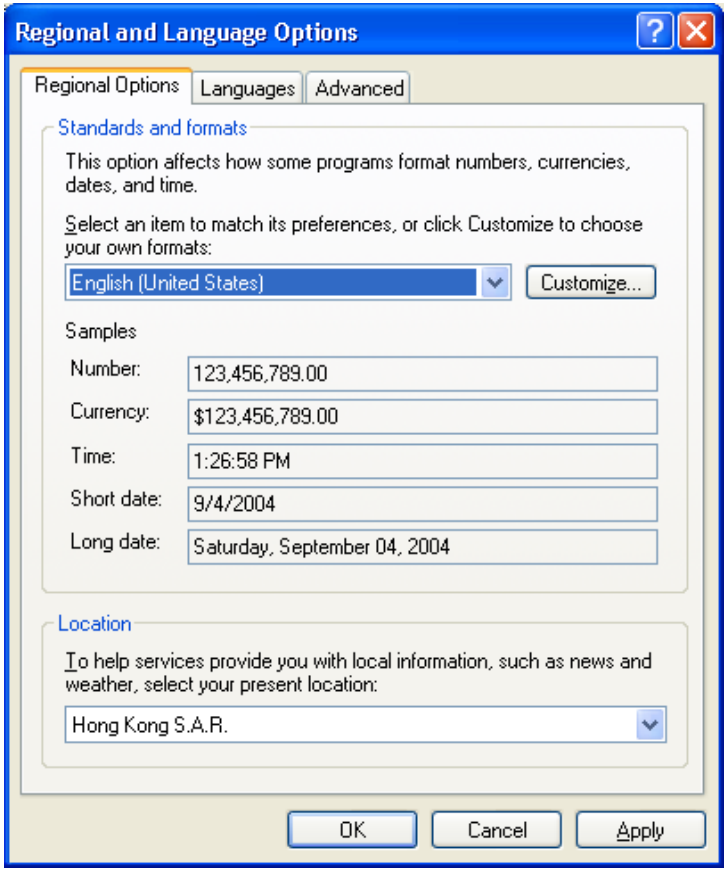
- Different interfaces are required for users with different cultural background.
- Internationalization is required for the worldwide computer market.
- Hardware and user-interface design concerns for internationalization should be addressed.

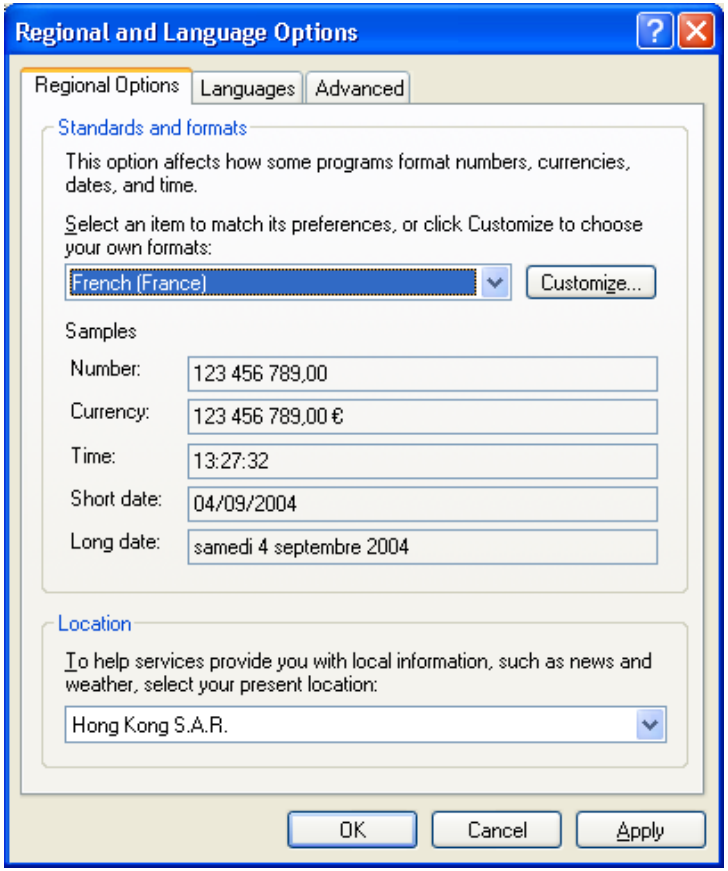
Example

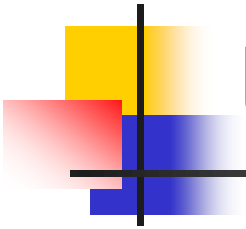

Yahoo! Australia & NZ - Microsoft Internet Explorer
YAHOO! AUSTRALIA & NZ
you'll find staff FAST
Place a job ad
Watch Now
MUSIC
Entertainment
Local TV Guide
Marketplace
Discount Laptops


Yahoo! Hong Kong - 雅虎香港 - Microsoft Internet Explorer
YAHOO! 雅虎香港
購買Norton Internet Security 即時減得$150優惠
SALE
100件省 全場 $1
立即掃貨
300張相 一個mail睇晒!
即時新聞
網上推介
著數特區
人氣熱賣

Example


Regional and Language Options
Regional Options
Languages
Advanced
Standards and formats
This option affects how some programs format numbers, currencies, dates, and time.
Select an item to match its preferences, or click Customize to choose your own formats:
English (United States)
Customize...
Samples
Number: 123,456,789.00
Currency: $123,456,789.00
Time: 1:26:58 PM
Short date: 9/4/2004
Long date: Saturday, September 04, 2004
Location
To help services provide you with local information, such as news and weather, select your present location:
Hong Kong S.A.R.
OK
Cancel
Apply


Regional and Language Options
Regional Options
Languages
Advanced
Standards and formats
This option affects how some programs format numbers, currencies, dates, and time.
Select an item to match its preferences, or click Customize to choose your own formats:
French (France)
Customize...
Samples
Number: 123 456 789,00
Currency: 123 456 789,00 €
Time: 13:27:32
Short date: 04/09/2004
Long date: samedi 4 septembre 2004
Location
To help services provide you with local information, such as news and weather, select your present location:
Hong Kong S.A.R.
OK
Cancel
Apply

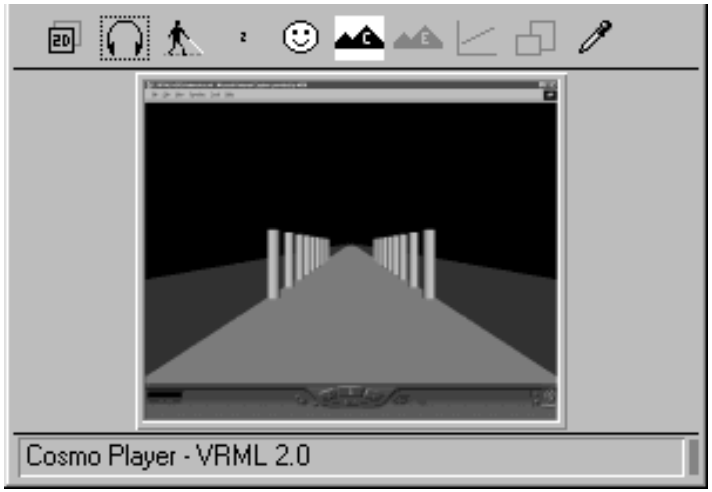


Users with Disabilities

- Users with visual impairments
  - Text-to-speech conversion, speech recognition.
- Users with hearing impairments
  - Conversions of tones to visual signals
- Users with mobility impairments
  - Speech recognition, eye-gaze control, head-mounted optical mouse

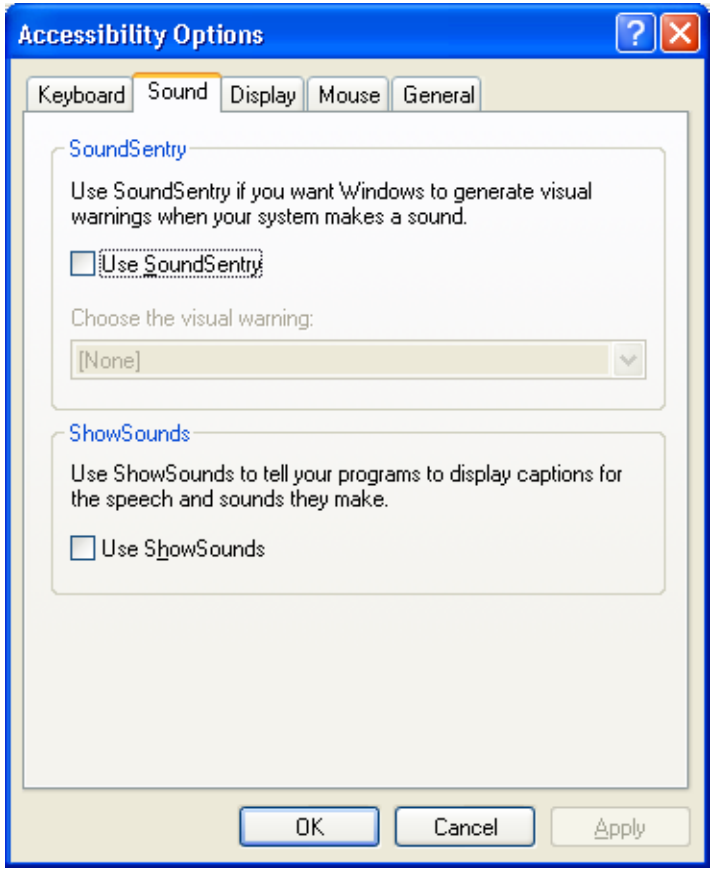
Example: Visual Impairment

Text Reader

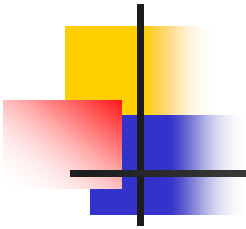


Audio representation of images

Example: Hearing impairment



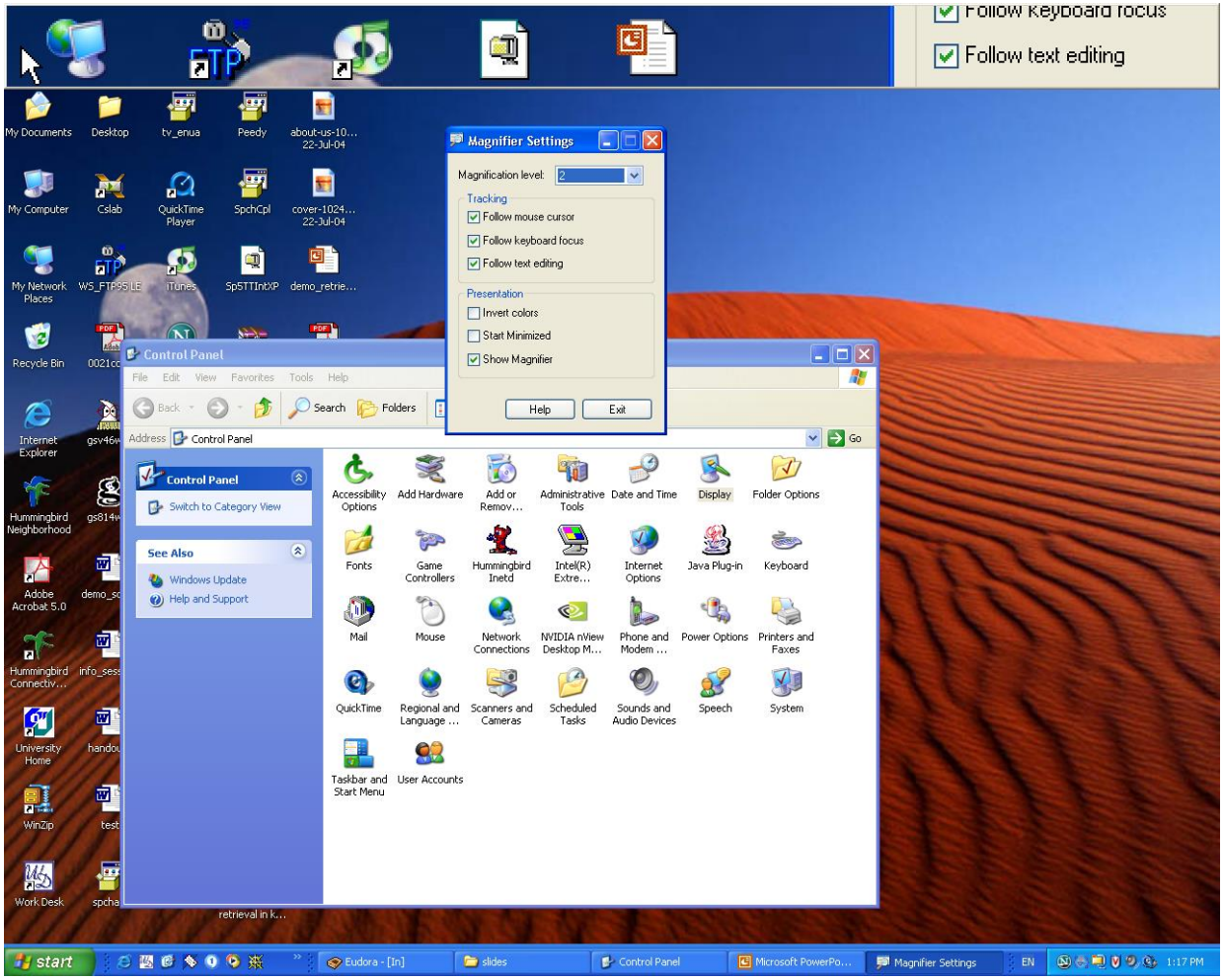
Example: Mobility impairments



Elderly Users

- Some interface designs to improve access for elderly users:
  - Larger fonts
  - Higher display contrasts
  - Easier-to-use pointing devices
  - Louder audio tones
  - Simpler command languages

The Magnifier



Other Examples