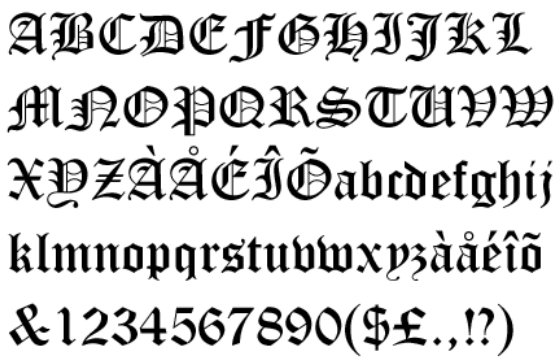
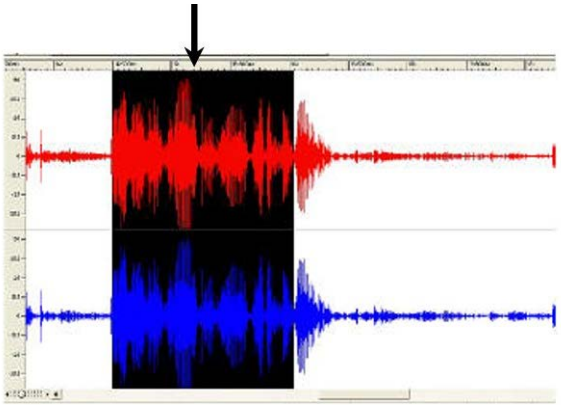
Introduction to Multimedia

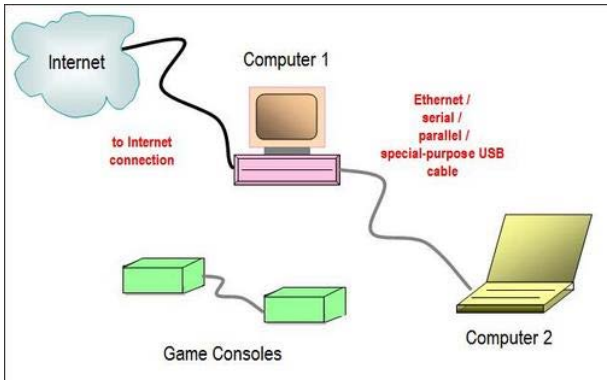
Introduction

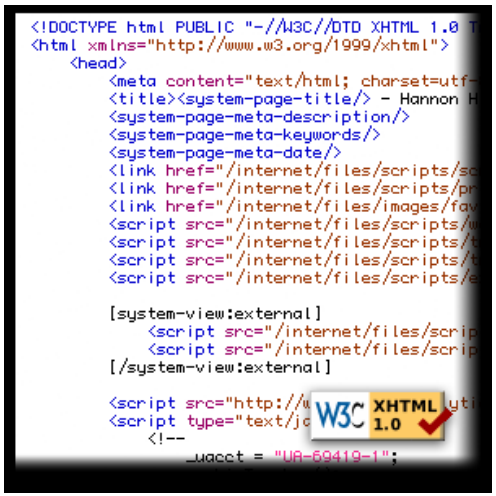
- **What is Multimedia?**
- Multimedia Software Tools
- Interactivity
- Design Issues
- Source Coding
- Legal Issues

What is Multimedia?





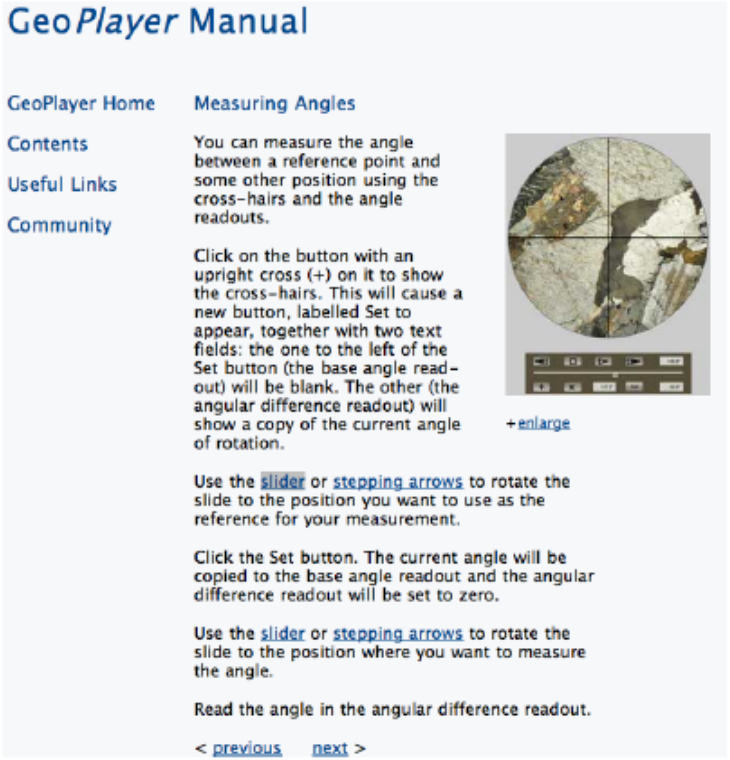




What is Multimedia?

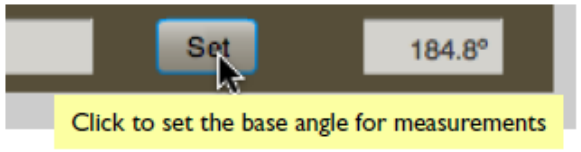
- Media
  - the storage and transmission channels or tools used to store and deliver information or data.
  - http://en.wikipedia.org/wiki/Media_%28communication%29
  - Another definition: A set of coordinated channels spanning one or more modality which have come, by convention, to be referred to as a unitary whole, and which possess a cross-channel language of interpretation.
- Key concept:
  - Media is a carrier: storage or transmission channel.
  - This carrier is used to carry information.

What is Multimedia?



A Web page

Video



A tool tip

What is Multimedia?

- Time-based media: changes over time
  - Video, animation, sound …
- Static media: do NOT change over time
  - Still images, text
- Each medium has its own characteristics, leading to distinctive strengths and weakness
- Choose the most appropriate medium for your purpose

What is Multimedia?

- How about multimedia?
  - media and content that uses a combination of different content forms.
  - E.g. includes a combination of text, audio, still images, animation, video, and interactivity content forms.
  - http://en.wikipedia.org/wiki/Multimedia

- Key Components
  - Modality
  - Channel of communication
  - Media (see discussions above)

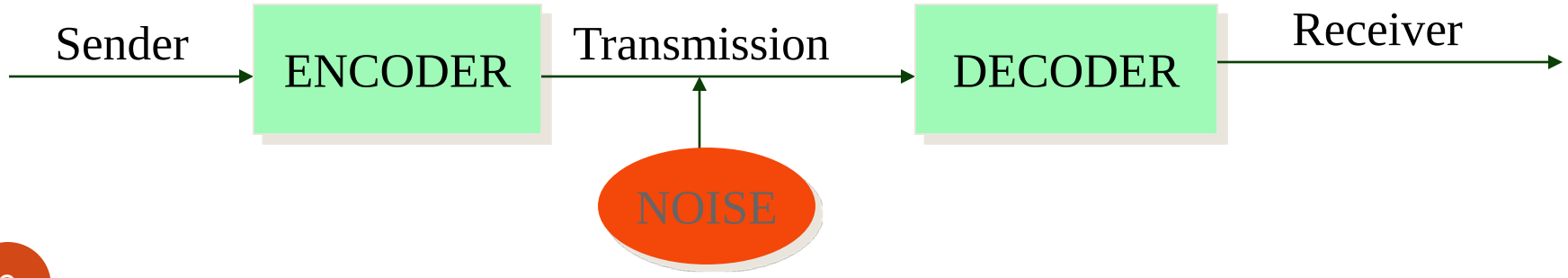
What is Multimedia?

- Modality: sensory systems available to human beings

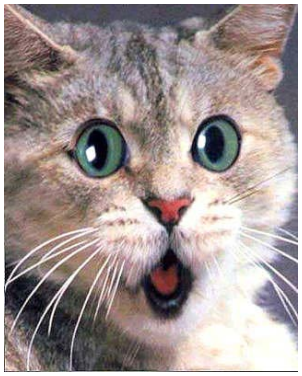
Modality	Sensory	Sense Organ
Tactile	Touching	Skin
Gustatory	Tasting	Tongue
Visual	Seeing	Eyes
Auditory	Hearing	Ears
Olfactory	Smelling	Nose

What is Multimedia?

- Channel of Communication
  - A connection between an encoder and a decoder such that information is encoded by the encoder, transmitted along the channel and decoded by the decoder to produce the same information at the other end of the channel.
  - There are various types of channels of communication.
  - A channel of communication exists within a single modality; A modality may include many channels of communication.



What is Multimedia?

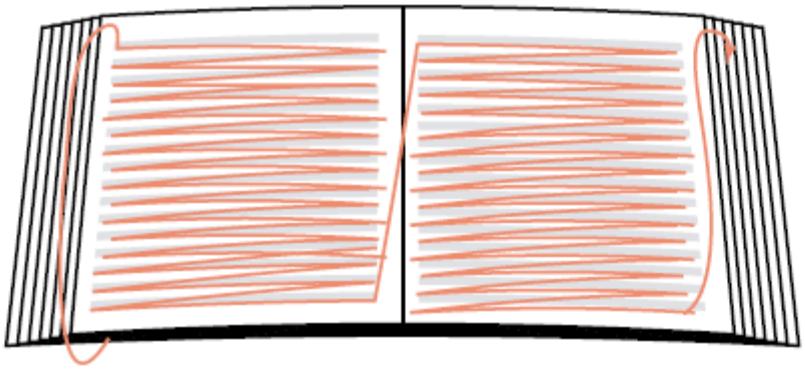


- What is digital multimedia?
  - "digitalized" multimedia
- An important relation between multimedia and computer.
  - Computer processes digitalized information
  - We only discuss digitalized multimedia, including how to digitalize
- Why digitalized?
  - Easy to represent, store, transmit, process…
  - Can you think more?

What is Multimedia?

- Linear Structure in conventional media

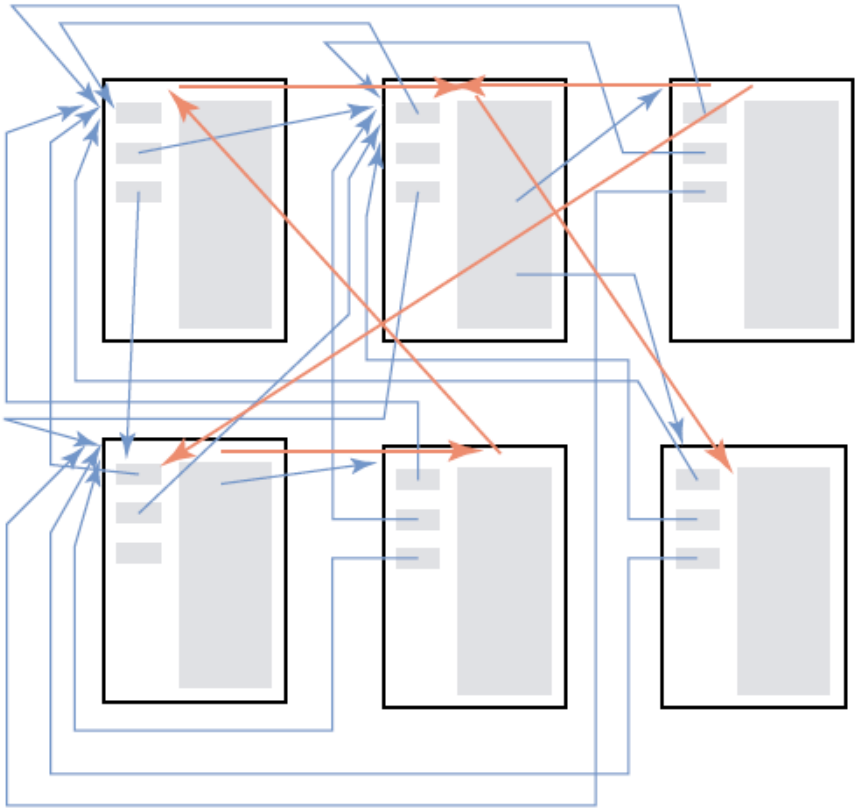
Book: physical arrangement of text and pages implies a linear reading order.



Film: fixed order of frames defines a single playback sequence.

What is Multimedia?

- Users can interact with digital multimedia in novel ways, leading to non-linear structures



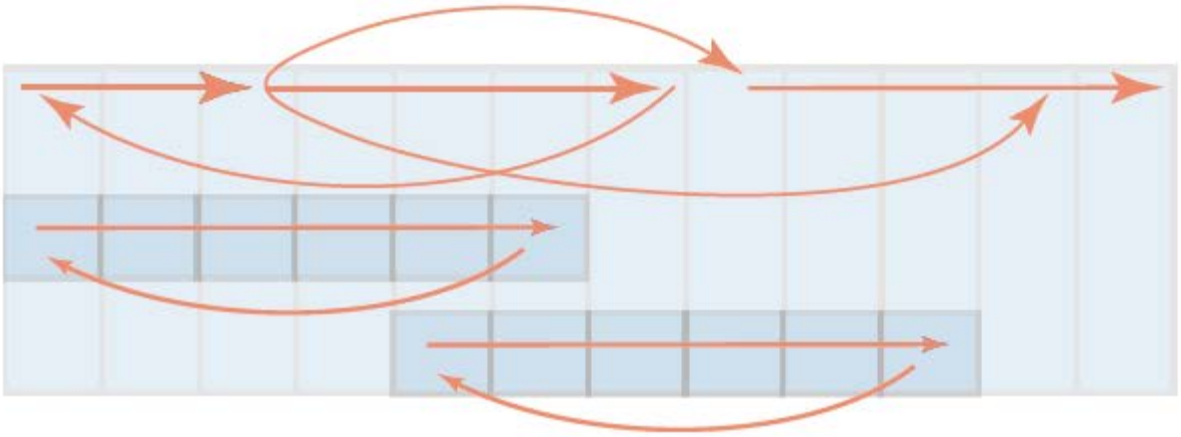
Hypermedia: links between pages permit multiple arbitrary reading orders.

What is Multimedia?

- Hypermedia
  - An extension of the term hypertext.
  - A **non-linear** medium of information which includes graphics, audio, video, plain text and hyperlinks.
  - Multimedia=Hypermedia+ non-interactive linear presentations.
    - World Wide Web (WWW) is a classic example of hypermedia.
    - Film in cinema is multimedia but not hypermedia.

What is Multimedia?

- Nonlinear Structure (cont.)



Flash: jumps between frames controlled by interactivity; independent movie clips play in parallel.

What is Multimedia?

- Some comments:
  - Digital multimedia can interact with other sorts of data and computation, serving as a user interface to databases and applications.
  - Multimedia is a relatively immature technology, although its adoption is accelerating with the increasing power of computer systems.
  - The history of the development of film demonstrates that it takes much more time than multimedia has existed for new media forms to develop fully.
  - Most multimedia adapt the forms of older media, but unique new forms are beginning to emerge.

Introduction

- What is Multimedia?
- **Multimedia Software Tools**
- Interactivity
- Design Issues
- Source Coding
- Legal Issues

Multimedia Software Tools

Digital Audio	Macromedia Sound Edit, CoolEdit
Music Sequencing and Notation	Cakewalk, Cubase Logic Audio, Marc of the Unicorn Performer
Image/Graphics Editing	Adobe Photoshop, Adobe Premiere Macromedia Freehand, GIMP ……
Animation	Avid SoftImage, OpenGL
Multimedia Authoring	Macromedia Director, Authorware
Website Design	Adobe Fireworks, Dreamweaver…
Flash	Macromedia Flash
……	……

Some Multimedia Applications

- Digital video editing and production systems
- Electronic newspapers/magazines
- World Wide Web
- Online reference works: e.g. encyclopedia, etc
- Home shopping
- Interactive TV
- Multimedia courseware
- Video conferencing
- Video-on-demand
- Interactive movies

Exercises

- Question
  - Do you think a lecture to be an example of linear(time-based) multimedia?
  - In what context do you encounter linear structures on a web?

Introduction

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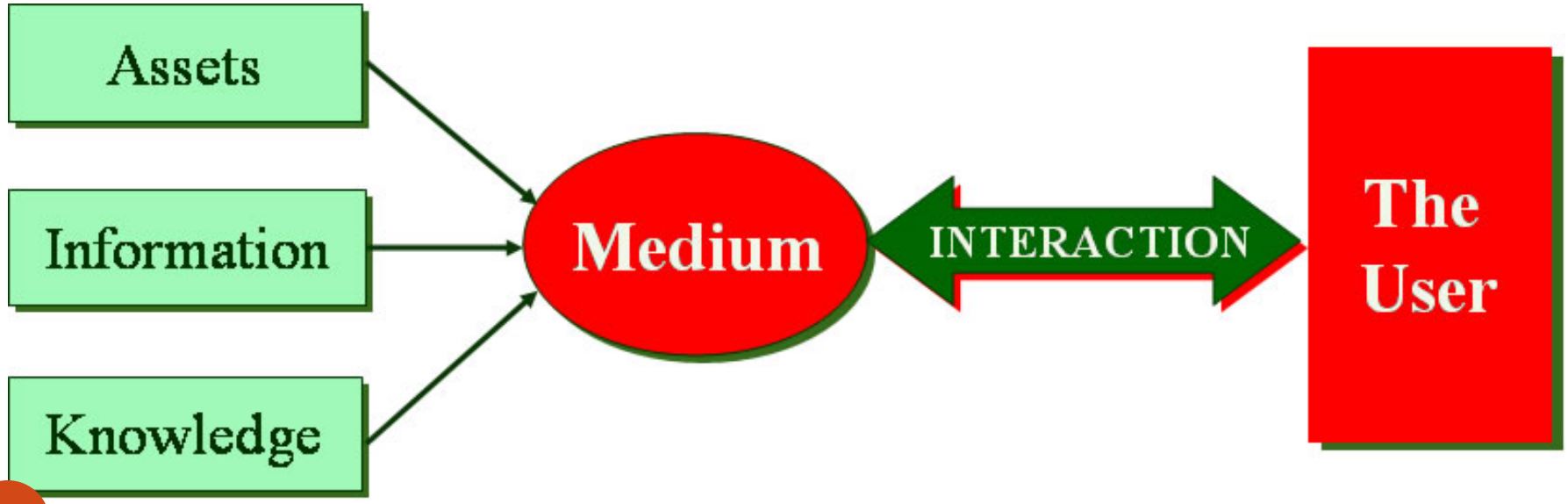
Interactivity

- Interactive Multimedia
  - An integrating relationship between multimedia and interaction
  - A multimedia system in which related items of information are connected and can be presented together
  - A combination of:
    - knowledge and information
    - a set of technologies
    - a set of multimedia components (modality, channels of communication, medium)
    - a set of collaborative systems
    - virtual environments

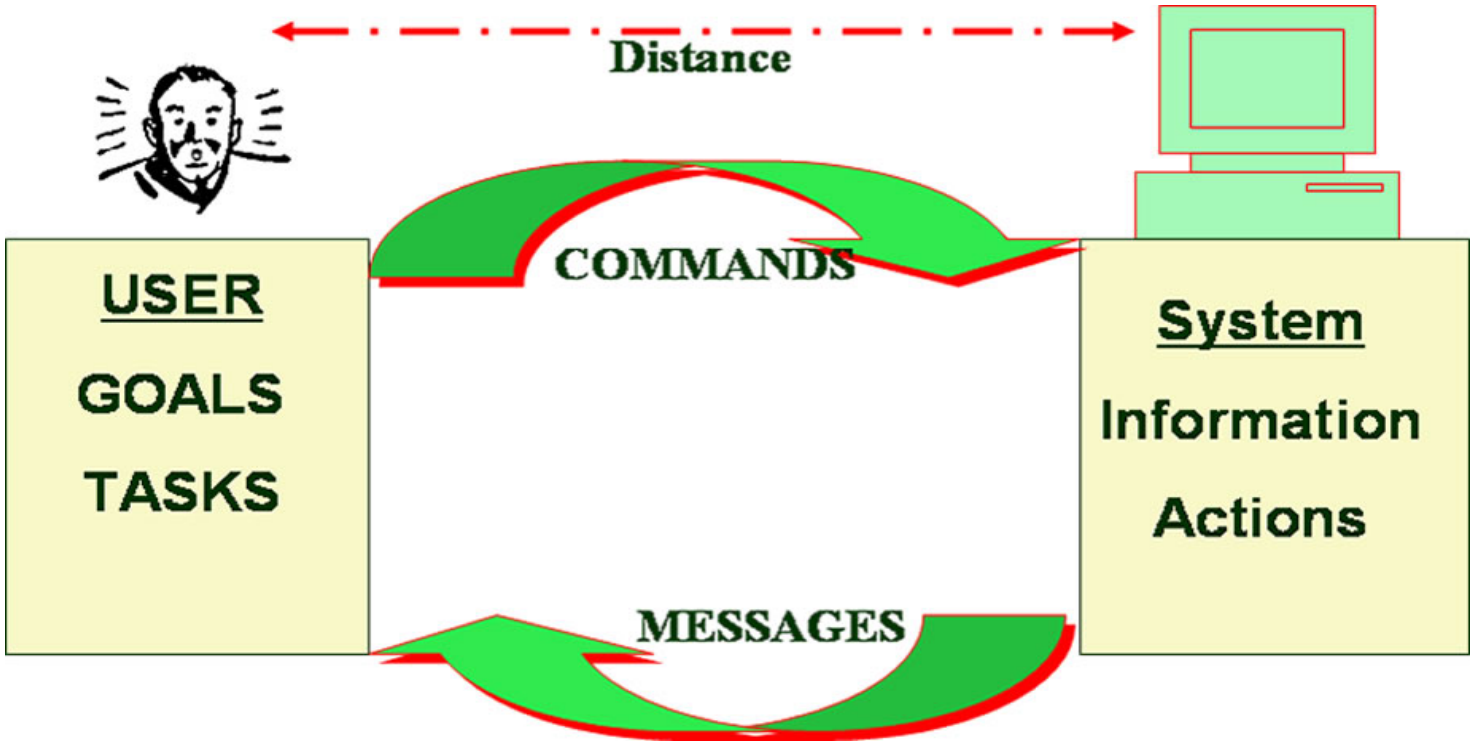
Interactivity

- Components of Interactive Multimedia
  - Asset – an object which encapsulates a single piece of 'media' (e.g. video, sound clip, graphic)
  - Information – the collection of data by a particular encoding
  - Knowledge – the interpretation and understanding of information



Interactivity

- Human Computer Interface (HCI)
  - HCI – the field concerned with the interface between humans and all forms of computer systems



Interactivity with Multimedia

- Example: Hyperlinks
  - In hypertext, some means of indicating that a link can be followed by clicking is required.
  - There is no precedent for this requirement in traditional media. The nearest thing is cross-reference in print.
  - Underlining and blue colouring is the most common signifier for links. It may be implemented in CSS (Cascading Style Sheets) as a text decoration or a bottom border on a elements.

- Visit Macao Polytechnic Institute's website for more details
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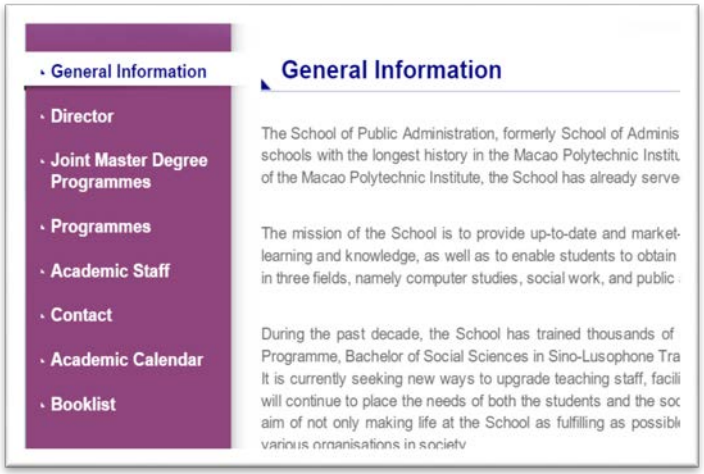
Interacting with Multimedia

- It is common practice to add some highlight to links when the cursor moves over them, to indicate that something will happen if a user clicks.
- Navbars and other collections of links may be moved to a separate area, where their function is evident without additional decoration.
- Users often expect images to have links on them. Provide a link where possible, but avoid using an image as the only link to a destination.

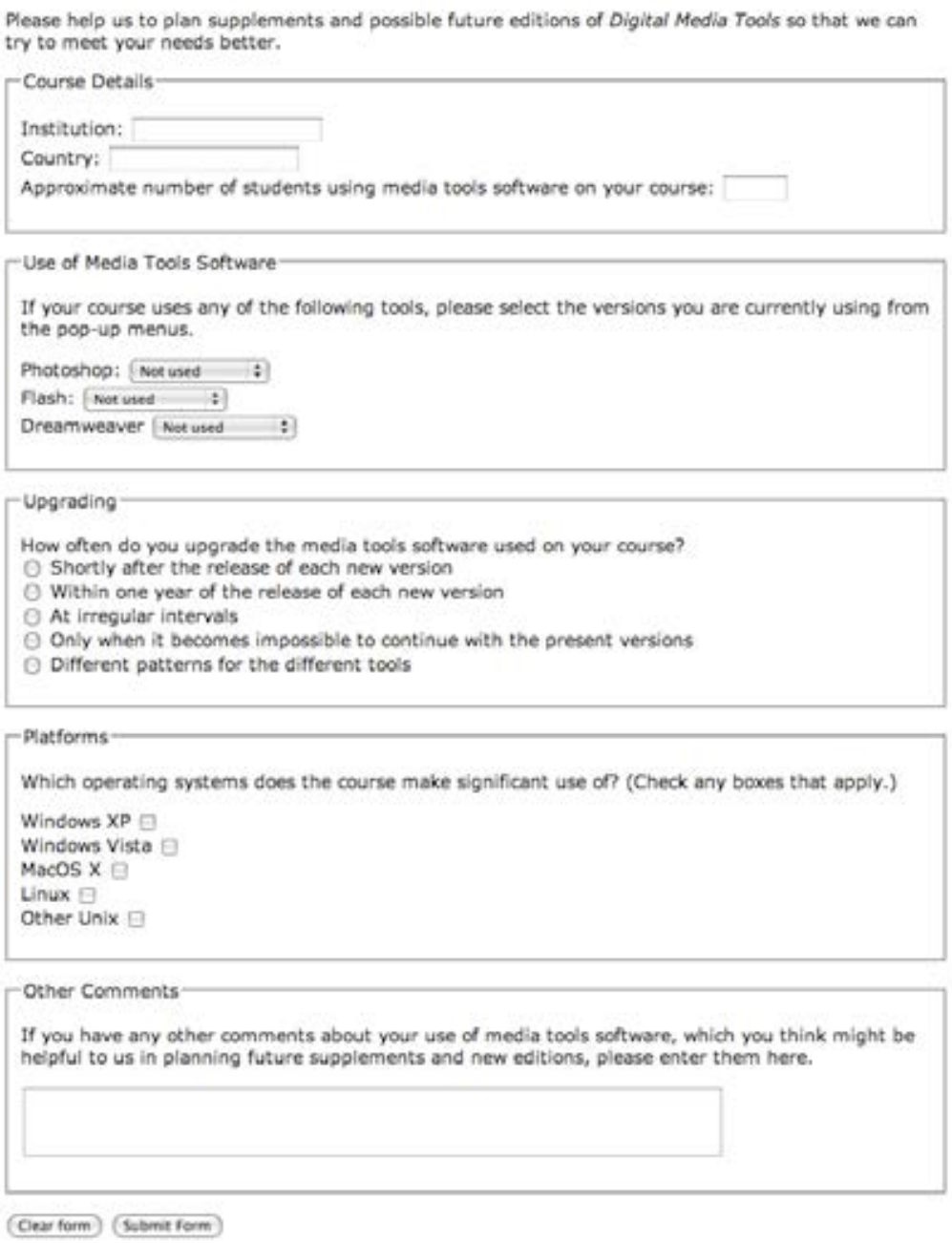


Interactivity with Multimedia

- Interacting through Multimedia
  - By embedding controls, we can provide ways of interacting with data or computation. Standard dialogue controls can be used for such purposes.
  - XHTML provides input elements, for text fields, check boxes, radio buttons, etc., text area for multiple lines of text and select and option elements for pop-up menus and lists. These elements are used within a form to send data to a script on the server.

type Attribute	Control	Type-specific Attributes
text	text input field	maxlength
checkbox	check box	checked, value
radio	radio button	
submit	submit button	
reset	reset button	
button	push button	
file	file selector	

Principal types of input element



Text fields

Pop-up menus

Radio buttons

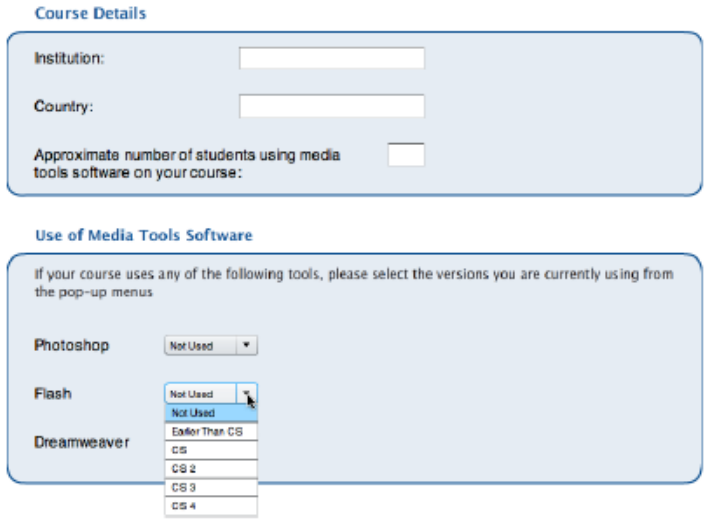
Check boxes

Text area

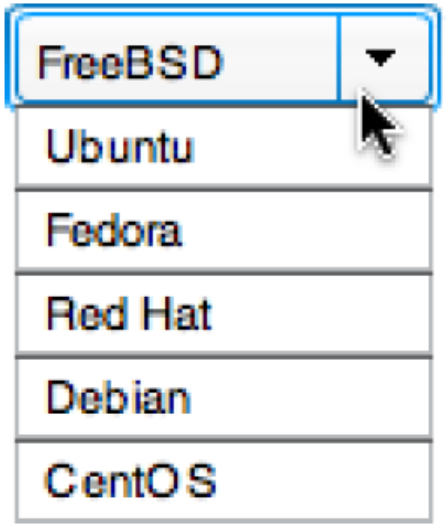
button

Interactivity with Multimedia

- Interacting through Multimedia
  - Flash UI components provide the same controls, plus a few others. They must be combined with some ActionScript to do anything useful.



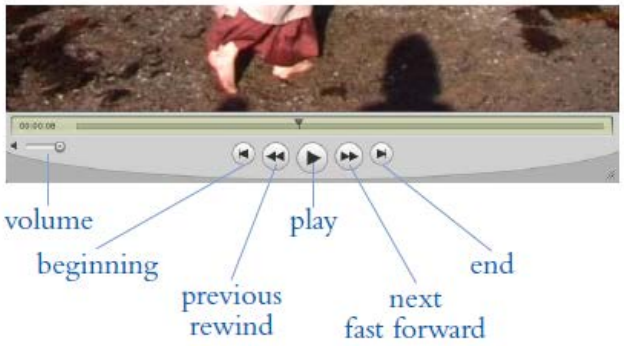
Flash text field, label and combo box components



A ComboBox

Interactivity with Multimedia

- Example:
  - Controls used by software for playing time-based media are derived from an established set of buttons used by physical media players: play, pause, stop, rewind, fast forward.
  - Software allows controls to be more flexible than physical equivalents.



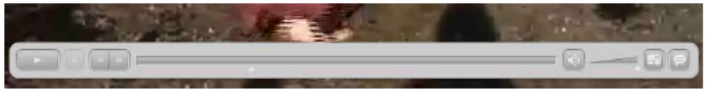
QuickTime Player controls

QuickTime Player controls while playing

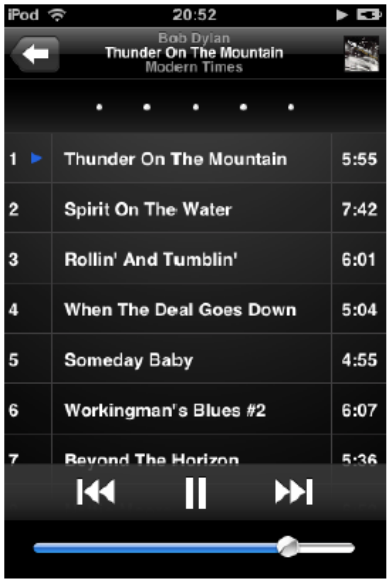
Interactivity with Multimedia

- Example (cont.):
  - Media player controls use semiotic and gestalt principles: a set of standard icons are arranged so that they are perceived as a unit.

Windows Media Player controls



Flash video playing controls



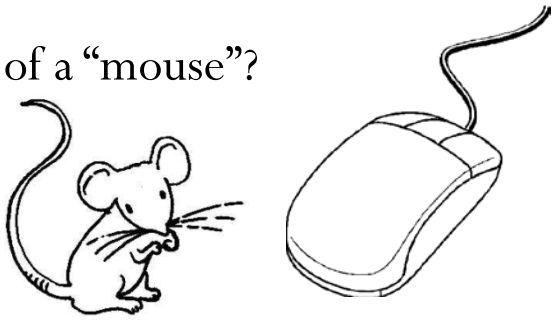
iPod touch controls

Interactivity with Multimedia

- Interacting through Multimedia (Further examples)
  - Flash movie clips and ActionScript can be used to create interfaces that are not restricted to using standard controls.
  - Flash-based interfaces can be used in a web browser or in desktop applications.
  - Multimedia applications which do something new may require innovative interface design.
  - Users will draw on existing experience when trying to use new interfaces, so familiar features and ideas should be used where possible.
  - JavaScript and other web-standard technology can be used to program multimedia interfaces, but the possibilities are less extensive than those which Flash offers. JavaScript libraries are used to make the task simpler.

Interactivity

- Question
  - Do you think microsoft windows provide a good HCI to its users?
  - Or, which HCI is the best? DOS? Windows? OS/2? MAC OS? UNIX?
  - How do you rate the operating systems on mobile phones?
  - Can you provide any hint in further improving their ***usability***?
  - Suppose you are in charge of a software system, are you willing to devote much effort to HCI design?
  - How do you think about the contribution of a "mouse"?



Introduction

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- **Design Issues**
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Visual Design

- Visual Communication
  - Semiotics
- Gestalt Principles
  - Grouping, Visual Hierarchy
- Colour and Tone
  - Colour in Multimedia design
  - Combining Colours
- Layout Grids
  - Alignment
  - Grids

Design Issues

- Poor visual design is one of the main factors that lead to multimedia applications and Web sites being difficult to use.
- Visual communication depends upon a range of psychological, cultural and physical factors which cannot easily be quantified or systematized.
- Images and colors immediately convey impressions which cannot necessarily be adequately described in words.

Design Issues

- Which of the pages would make you want to visit Glenfingal?

Glenfingal

Location: west Scotland. See map
Population: 450
Bird species: 121
Local **industries:** tourism, agriculture, fish farming

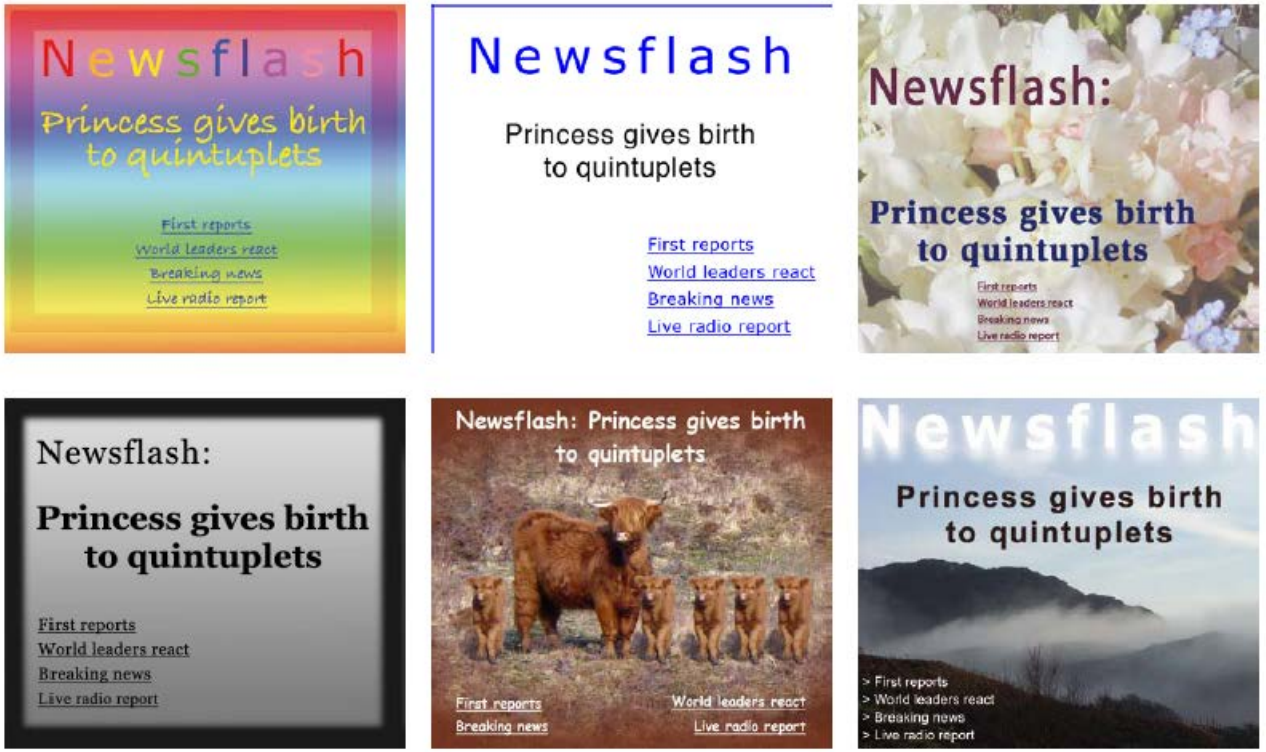
Glenfingal can be reached by a range of transport facilities and offers varied holiday accommodation.

Glenfingal offers:
- a *peaceful*, remote location
- plentiful *wildlife*
- natural *beauty*
- long *summer evenings*
- frequent *sunsets*

Combination of photo, warm colour, font and navbar

Design Issues

- Visual communication may alter the meaning of what is being communicated by words, in a gross or subtle way.



Interaction of textual and visual communication

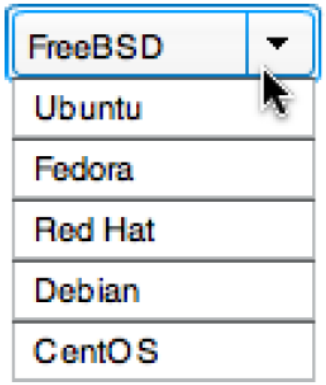
Design Issues

- Semiotics is the study of systems of signs and the relationship between signifier and signified within them.
- Signifier: a sign's form e.g., a word or a graphic symbol.
- Signified: specific meaning or concept which a sign refers to.
- The relationship between the signifier and the signified is arbitrary and can only be understood within a particular system of signs.

Arrows as signifiers

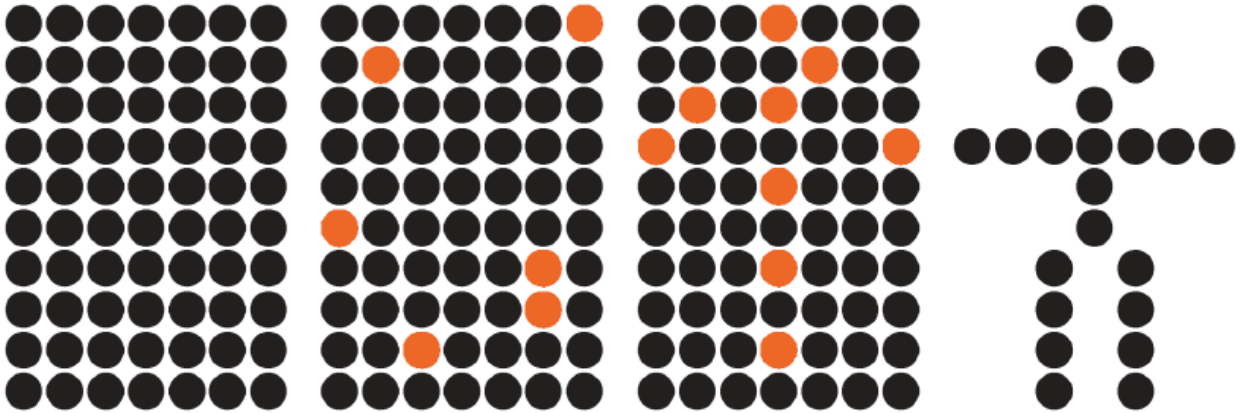
Design Issues

- Convention, context and users' experience determine whether a user will understand a sign correctly.
- Advantages of using graphic symbols
  1. Graphic symbols transcend language barriers.
  2. Graphic symbols are capable of conveying complex meanings succinctly and there may sometimes be no sensible alternative to using them.



Design Issues – Gestalt Principle

- Gestalt principles of visual perception are derived from the theories of gestalt psychology.
- They are concerned with how the human brain tends to organize the visual information that reaches it through eyes.



Gestalt principles of visual perception

http://en.wikipedia.org/wiki/Gestalt_psychology

Design Issues – Gestalt Principle

- Perception of patterns and structures may be determined by the grouping of objects in a visual field.
- The gestalt principles of proximity, similarity, symmetry, figure/ground and closure determine our recognition of grouping.

Design Issues

- Law of Proximity — Spatial or temporal proximity of elements may induce the mind to perceive a collective or totality.

Design Issues – Gestalt Principle

- Law of Similarity — The mind groups similar elements into collective entities or totalities. This similarity might depend on relationships of form, color, size, or brightness.

Gestalt Principle

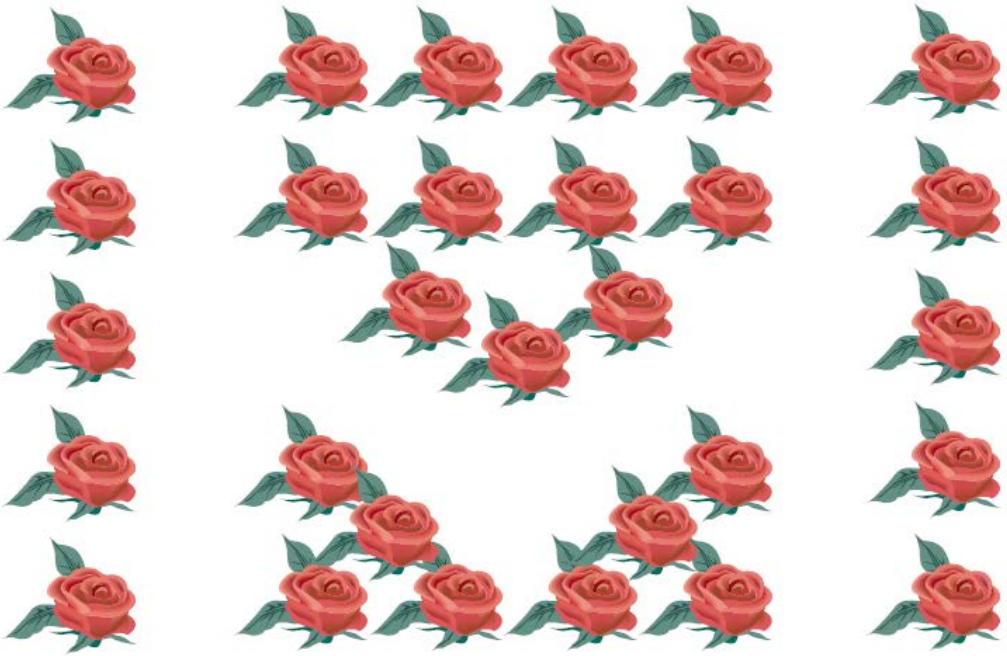
Synthetic image (different brightness and resolution)

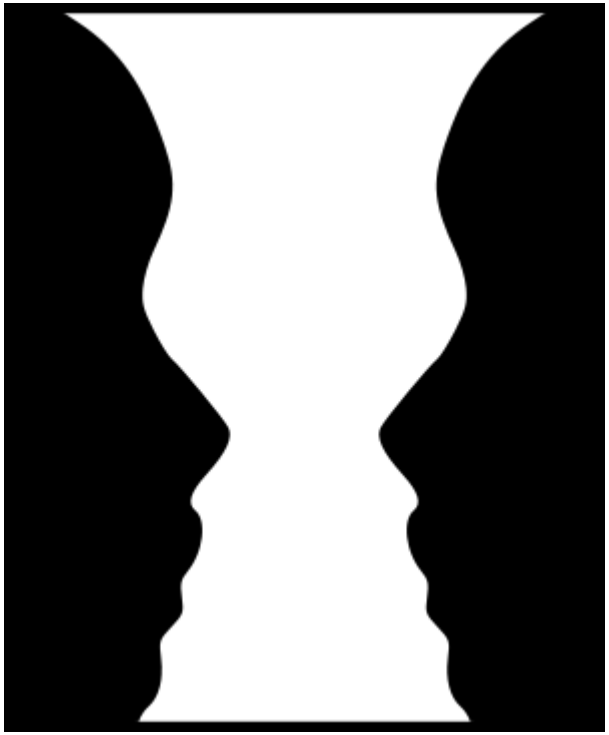
Gestalt Principle

- Law of Symmetry — Symmetrical images are perceived collectively, even in spite of distance.

Gestalt Principle

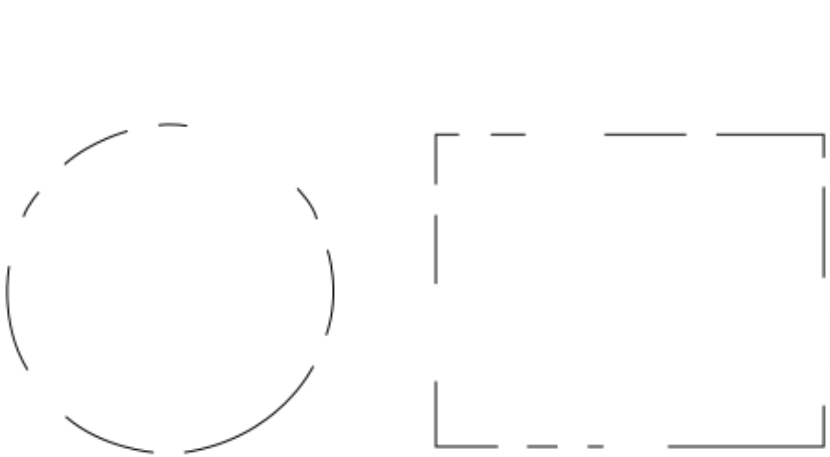
- Figure/Ground — convey two visual ideas at the same time





Design Issues – Gestalt Principle

- Law of Closure: The mind may experience elements it does not perceive through sensation, in order to complete a regular figure (that is, to increase regularity).

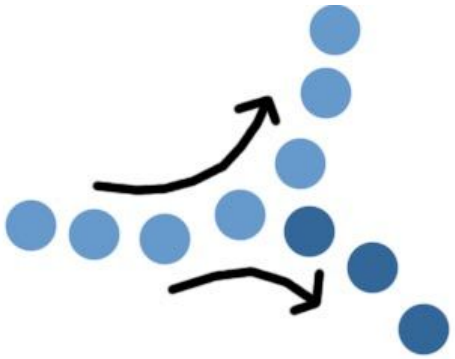


The famous use of Law of Closure

- Who bites the apple?

Design Issues – Gestalt Principle

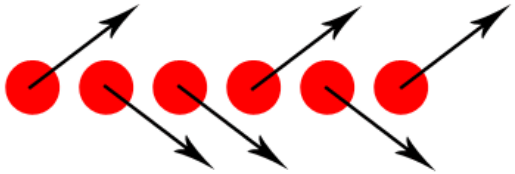
- Law of Continuity — The mind continues visual, auditory, and kinetic patterns.
- Law of Common Fate — Elements with the same moving direction are perceived as a collective or unit.



Law of Continuity:

Lines are seen as following the smoothest path.

In the image above, the top branch is seen as continuing the first segment of the line. This allows us to see things as flowing smoothly without breaking lines up into multiple parts.



Design Issues – Gestalt Principle

- Non-symbolic ordering based on the gestalt principles is the foundation of structure in visual design.
- The precise appearance and arrangement of objects may lead to one principle dominating the others.
- Ignoring gestalt principles often results in a confusing design.

Monday	**Heavy Rain**
Tuesday	Heavy Rain
Wednesday	HEAVY RAIN
Thursday	Heavy Rain
Friday	**Heavy Rain**
Saturday	***Heavy Rain***
Sunday	*Heavy Rain*

A confusing absence of similarity

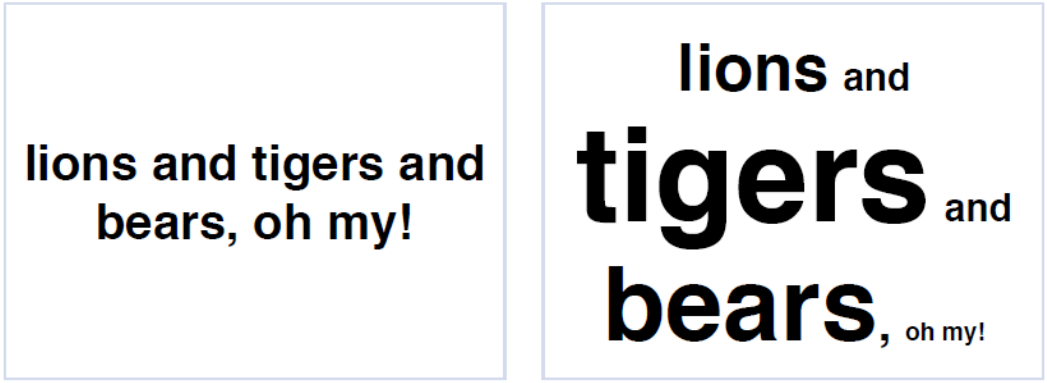
Design Issues – Gestalt Principle

- The component parts of an interface or Web page should usually be organized according to gestalt principles.
- Navbars on Web pages, and the conventional arrangement of controls on media players illustrate the application of gestalt principles to multimedia design.

Using gestalt principles in Web page design

Design Issues – Gestalt Principle

- Visual hierarchy describes the dominance of one or more elements in the visual field.
- Like other hierarchies, it may have many levels.
- Visual hierarchy may be achieved by applying gestalt principles "inversely", in order to disrupt grouping and make one or more elements appear dominant.



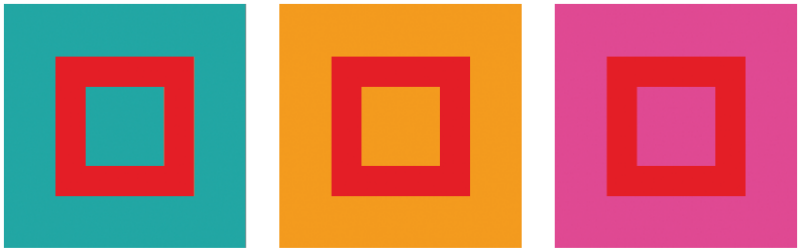
Expressing hierarchical emphasis through type size

Design Issues – Gestalt Principle

- Visual hierarchy is not necessarily determined by size.

Design Issues – Color & Tone

- Color plays many roles in visual design, affecting visual hierarchy, perception of structure, and even meaning.
- Individuals' responses to color may be emotive, or determined by fashion or culture.
- When colors are juxtaposed, the perceived appearance is modified.
- Hue and brightness may appear to be modified when the same color is placed against different backgrounds.



The effect of colour combinations on perception of colour

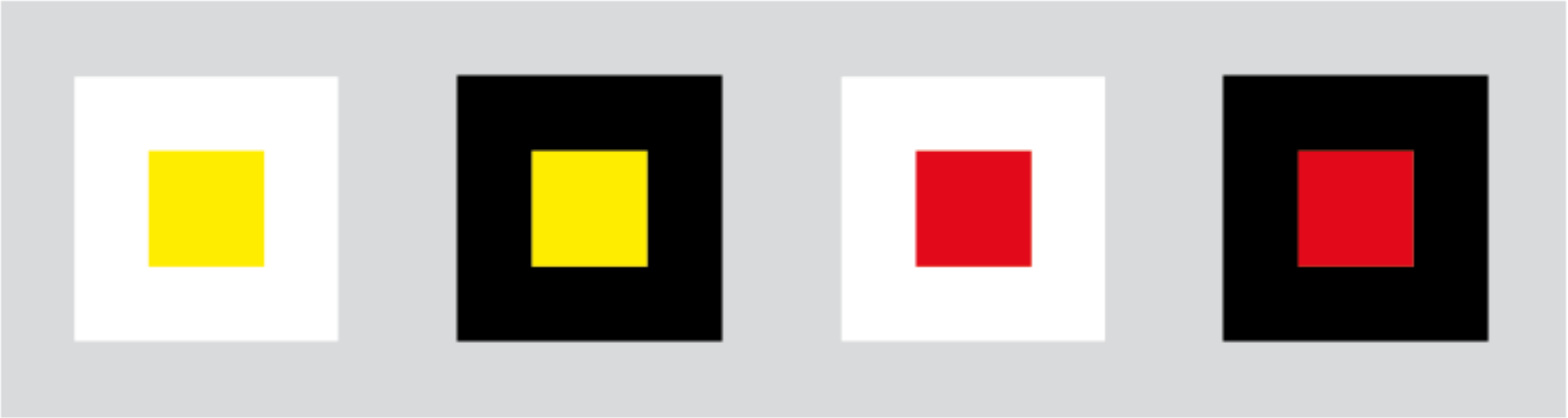
Design Issues – Color & Tone

- Large flat areas of a single color look quite different from pixels of the same color within an image.

Colours removed from their pictorial context

Design Issues – Color & Tone

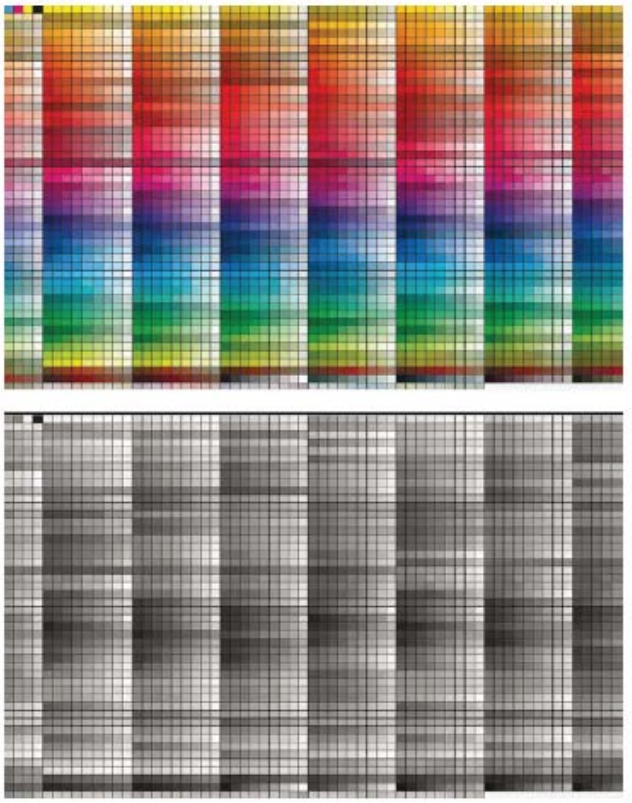
- Colors may seem to advance or recede when placed on different-colored backgrounds.



The effect of colour combinations on perception of size

Design Issues – Color & Tone

- Tonal contrast affects perception of the distinction between figure and ground.
- Contrast therefore affects the legibility of text.
- It can be difficult to judge the contrast between colors of different hues.



Colours and tones

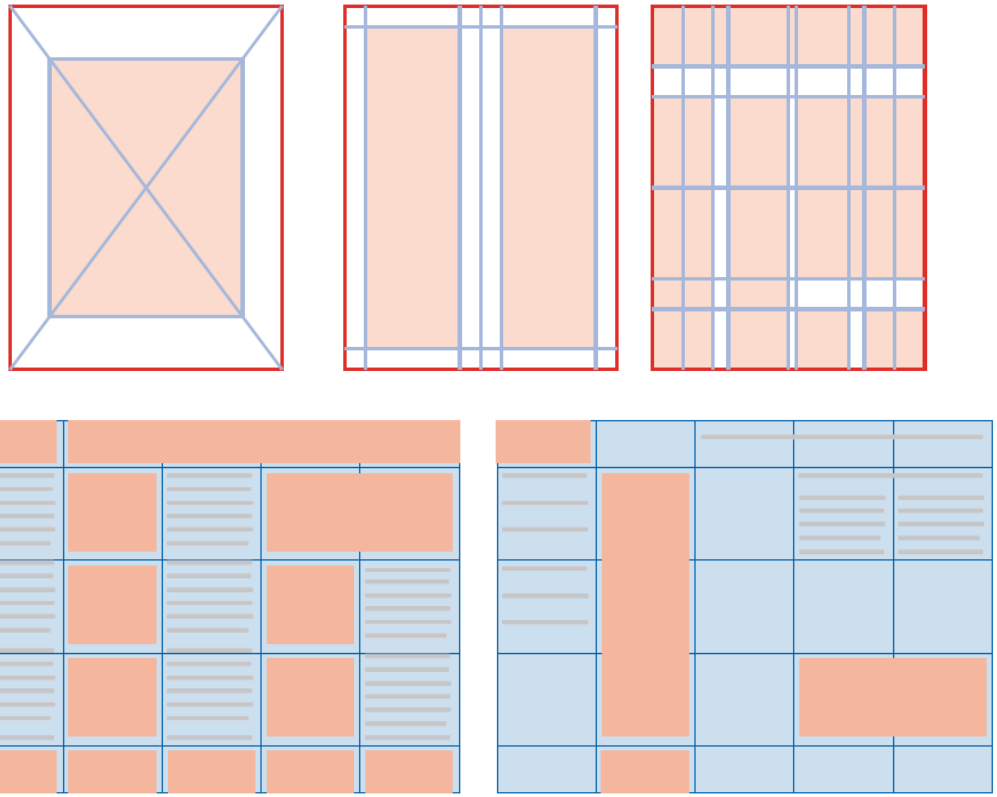
Design Issues – Color & Tone

- As people age, less light enters the eye, so a smaller range of tonal values is perceived.
- Many people suffer from defective color vision, most commonly an inability to distinguish between red and green.
- The tonal contrast of colored designs should be tested by converting to greyscale.

Different colours with similar tonal values (red–green confusability)

Design Issues – Layout Grids

- A layout grid is a geometrical division of the page that can be used to structure the placement of text blocks and images.
- The grid itself is simply an aid to layout and remains invisible.



Design Issues – Layout Grids

- Alignment can give an appearance of coherence and visual order to a Web page or multimedia interface.
- It is sometimes necessary to misalign irregular objects slightly to make them look as if they are perfectly aligned.
- Hanging punctuation is used to prevent punctuation marks at the ends of lines of text appearing misaligned.

Aligned irregular shapes

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Hanging punctuation

Design Issues – Layout Grids

- Centred layouts may be problematic – images and headings may look untidy unless one of the aligned elements is significantly narrower than the other.

Centred alignment

Design Issues – Layout Grids

- Modified grids may be used to accommodate the dynamic dimensions of Web pages while maintaining a framework for vertical and horizontal alignments.
- Arbitrary grid layouts may be created in Flash.

Introduction

- What is Multimedia?
- Multimedia Software Tools
- Interactivity
- Design Issues
- **Source Coding**
- Legal Issues

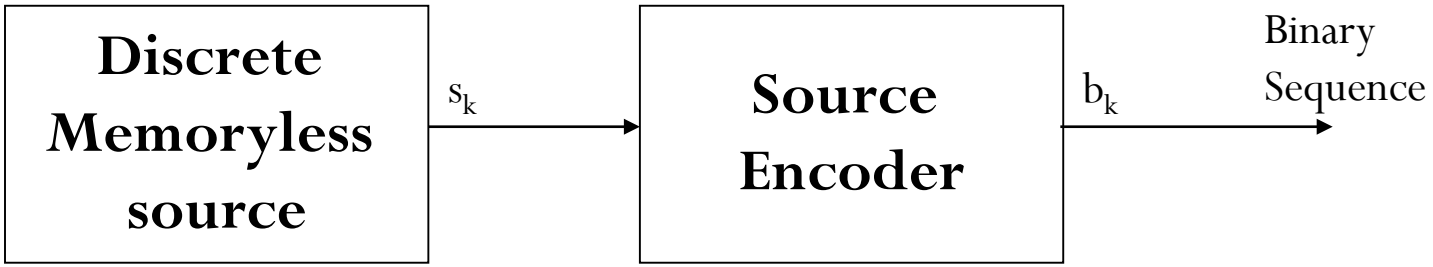
Source Coding

- In computer science and information theory, data compression or source coding is the process of encoding information using fewer bits (or other information-bearing units) than an un-encoded representation would use, through use of specific encoding schemes.
- http://en.wikipedia.org/wiki/Source_coding

Source Coding

- Source coding is a process by which data that is generated by a discrete source is represented efficiently.
- The knowledge of the statistics of the source is required in order to develop an efficient source code.
- In particular, we may assign short code-word to frequent source symbols and long codewords to rare source symbols.
- Such a source code is referred to as variable-length code.

Source Coding



Source Coding

- Consider a source that has an alphabet of K different symbols such that $\boldsymbol{s_k}$ is the k-th symbol in the alphabet.
- Also let $\boldsymbol{s_k}$ occur with probability $\boldsymbol{p_k}$ and let the binary codeword assigned to $\boldsymbol{s_k}$ by the encoder have length $\boldsymbol{l_k}$ measured in bits.
- The average codeword length of the source encoder is defined as

$$\overline{L} = \sum_{k=0}^{K} p_k l_k$$

Source Coding

- $\overline{L}$ represents the average number of bits per source symbol used in the source encoding process.
- If L_{min} denotes the minimum possible codeword length, the coding efficiency of the source encoder is defined as

$$\eta = \frac{L_{\min}}{\overline{L}}$$

- With $\overline{L} \geq L_{\min}$, then $\eta \leq 1$.
- The encoder is said to be efficient when η approaches 1.

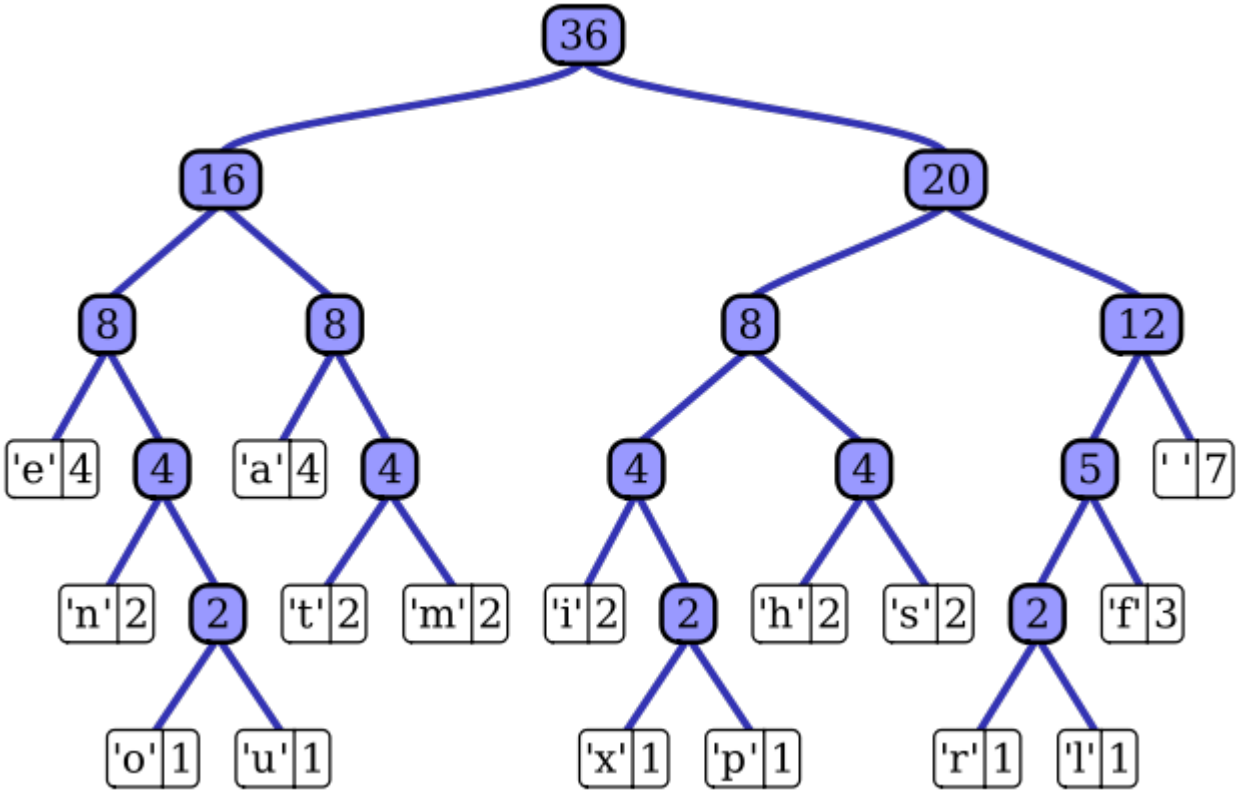
Source Coding

- Examples: The Huffman code
- The Huffman code is an efficient source code whose η approaches 1 (ie: average word length approaches the fundamental limit).
- Huffman code uses the statistics of the source to generate a binary sequence that represents the source symbols.

Source Coding

- The Huffman Algorithm proceeds as follows:
  1. The source symbols is listed in order of decreasing probability. The two source symbols with the lowest probability are assigned a 0 and a 1 (Splitting) .
  2. The two source symbols are regarded as being combined into a new source symbol with probability equal to the sum of the two original probabilities. The probability of the new symbol is placed in the list in accordance with its value.
  3. The procedure is repeated until we are left with a final list of source statistics of only two for which a 0 and a 1 is assigned.
- The code for each original source symbol is found by working back and tracing the sequence of 0s and 1s assigned to that symbol as well as its successors.

Source Coding



Char	Freq	Code
space	7	111
a	4	010
e	4	000
f	3	1101
h	2	1010
i	2	1000
m	2	0111
n	2	0010
s	2	1011
t	2	0110
l	1	11001
o	1	00110
p	1	10011
r	1	11000
u	1	00111
x	1	10010

"this is an example of a huffman tree"

Introduction

- What is Multimedia?
- Multimedia Software Tools
- Interactivity
- Design Issues
- Source Coding
- **Legal Issues**

Legal Issues

- Different countries/regions have different rules
- General guidance:
  - Respect others' work/privacy/assets…
  - Protect one's own work/privacy/assets…
- Distinguish the different types of licenses
  - E.g. GNU license, shareware, freeware, academic license, commercial license, student license…

Legal Issues

- Is it legal if:
  - Copy commercial software instead of buying it, then use it for educational purposes?
  - Use information from the internet without giving recognition?
  - Use information from another source without giving recognition?
  - Download a movie using P2P networks?