

Multimedia

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INTRODUCTION



Content

- ▶ Multimedia definition
- ▶ Elements of Multimedia
- ▶ Categories of Multimedia
- ▶ Characteristics of a Multimedia System
- ▶ Multimedia applications
- ▶ Multimedia Advantages and disadvantages

Multimedia Definition

- ▶ Derived from the word “Multi” and “Media”
 - ▶ Multi
 - ▶ Many, Multiple,
 - ▶ Media
 - ▶ Tools that is used to represent or do a certain things, delivery medium, a form of mass communication – newspaper, magazine / tv.
 - ▶ Distribution tool & information presentation – text, graphic, voice, images, music and etc.
- ▶ Multimedia is a combination of text, graphic, sound, animation, and video that is **delivered interactively** to the user by electronic or digitally manipulated means.

Elements of Multimedia

- ▶ **Multimedia** means that computer information can be represented through audio, image, video and animation in addition to traditional media (text and graphics).



Elements of Multimedia



- Text is the most basic element of multimedia.
- A good choice of words could help convey the intended message to the users (keywords).

Example

ROAD SAFETY Basic Intermediate Advanced

First, before crossing the road, make sure you look to your left, to your right and then left again.

Then, walk carefully to cross the road.

Elements of Multimedia



- Two-dimensional figure or illustration
- Could be produced manually (by drawing, painting, carving, etc.) or by computer graphics technology.
- Used in multimedia to show more clearly what a particular information is all about (diagrams, picture).

Example

ROAD SAFETY Basic Intermediate Advanced

First, before crossing the road, make sure you look to your left, to your right and then left again.



Then, walk carefully to cross the road.



Elements of Multimedia



- Produced by vibration, as perceived by the sense of hearing.
- In multimedia, audio could come in the form of speech, sound effects and also music score.

Example

ROAD SAFETY Basic Intermediate Advanced

First, before crossing the road, make sure you look to your left, to your right and then left again.

Then, walk carefully to cross the road.

Sound: NG11905

Effect: Custom

Sync: Start

44 kHz Stereo 16 Bit 67.2 s 806.9 kB

Timeline: 1 5 10 15 20 25 30 35 40 45 50 55

Layers: sound, pic3b, pic 3a, pic 2b, pic 1a

Frame: 33 12.0 fps 2.7s

Elements of Multimedia



- The illusion of motion created by the consecutive display of images of static elements.
- In multimedia, animation is used to further enhance / enriched the experience of the user to further understand the information conveyed to them.

Example



Elements of Multimedia



- Is the technology of capturing, recording, processing, transmitting, and reconstructing moving pictures.
- Video is more towards photo realistic image sequence / live recording as in comparison to animation.
- Video also takes a lot of storage space. So plan carefully before you are going to use it.

Categories of Multimedia

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Categories of Multimedia

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- A Multimedia Project is identified as Linear when:
 - It is not interactive
 - User have no control over the content that is being showed to them.
- Example:
 - A movie
 - A non-interactive lecture / demo show

Categories of Multimedia

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Multimedia Categories

Linear

Non-Linear

Advantages of linear presentations	Disadvantages of linear presentations
Predictable, every audience will see exactly the same presentation	Not very interactive with the audience, they cannot change the order of presentation
Relatively easy for another person to do the presentation should the author be unavailable as the presentation always runs in the same order	Not flexible in terms of changing the time taken to do the presentation, for instance a presentation planned for 1 hour may now need to be done in half an hour, this is not simple in a linear presentation
Simple to prepare handouts as slides are always in the same order	It is apparent to the audience they are not seeing the full presentation if slides need to be skipped
Timing of the presentation is very predictable	Can be boring as the audience may have to view slides that happen to be irrelevant to them

Categories of Multimedia

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- A Multimedia Project is identified as Non-Linear when:
 - It is interactive
 - Users have control over the content that is being showed to them.
 - Users are given navigational control
- Example:
 - Games
 - Courseware
 - Interactive CD

Categories of Multimedia

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Advantages of non-linear presentations	Disadvantages of non- linear presentations
Slides can be accessed in any order	More complicated than a simple linear presentation
User can go both forward and backwards through the slides should they want to view a particular slide again.	Harder to predict the timing of the presentation
Can provide a presentation that meets the needs of the individual user.	Harder to hand over the presentation for someone else to do
The presenter can use the same presentation for different audiences	Need to incorporate navigation method into the slides
Improved interactivity. Non-linear allows the presenter to invisibly skip slides should they want to, for instance the points covered in the next slide may now be irrelevant following a dialogue with the audience	Harder to prepare a set of handouts

Characteristics of a Multimedia System

- ▶ A Multimedia system has four basic characteristics:
 1. Multimedia systems must be **computer controlled**.
 2. Multimedia systems are **integrated**.
 3. The interface to the final presentation of media is **usually interactive**
 4. The information they handle must be **represented digitally**.

Characteristics of a Multimedia System

1.Computer Controlled

- ▶ •Producing the content of the information–e.g.by using the authoring tools, image editor ,sound and video editor
- ▶ •Storing the information–providing large and shared capacity for multimedia information.
- ▶ •Transmitting the information–through the network.
- ▶ •Presenting the information to the end user–make direct use of computer peripheral such as display device (monitor)or sound generator(speaker).

Characteristics of a Multimedia System

2. Integrated

- ▶ All multimedia components (audio, video, text ,graphics) used in the system must be some how integrated.
- ▶ Every device , such as microphone and camera is connected to and controlled by a single computer.
- ▶ A single type of digital storage is used for all media type.
- ▶ Video sequences are shown on computer screen instead of TV monitor.

Characteristics of a Multimedia System

3. Interactivity

- ▶ Level1: Interactivity strictly on information delivery. Users select the time at which the presentation starts, the order, the speed and the form of the presentation itself.
- ▶ Level2: Users can modify or enrich the content of the information, and this modification is recorded.
- ▶ Level3: Actual processing of users input and the computer generate genuine result based on the users input.

Characteristics of a Multimedia System

4. Digitally Represented

- ▶ Digitization: process involved in transforming an analogue signal to digital signal.

Applications of Multimedia

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- ▶ There are a number of fields where multimedia could be of use. Examples are:-
 - ▶ Business
 - ▶ Education
 - ▶ Entertainment
 - ▶ Home
 - ▶ Public Places

Applications of Multimedia

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► Business

- Use and Applications
 - Sales / Marketing Presentation
 - Trade show production
 - Staff Training Application

► Education

- Use and Applications
 - Courseware / Simulations
 - E-Learning / Distance Learning
 - Information Searching

► Entertainment

- Use and Applications
 - Games (Leisure / Educational)
 - Movies
 - Video on Demand (Online)

Applications of Multimedia

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► Home

- ▶ Use and Applications
 - ▶ Television
 - ▶ Satellite TV
 - ▶ Some services (chats, voting, reality TV)

► Public Places

- Use and Applications

- Smart Cards, Security

- Information Kiosk

- A product which is usually stationed at public places and allow the user to find information interactively and also other types of transaction.

- Characteristics of Kiosk Products:-

- ✓ Limited target users and usage.
- ✓ User friendly and easily used by user.
- ✓ Fast response.



1. Enhancement of Text Only Messages

- Multimedia enhances text only presentations by adding interesting sounds and compelling visuals

Multimedia Advantages

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2. Improves over Traditional Audio-Video Presentations

- ▶ Audiences are more attentive to multimedia messages than traditional presentations done with slides or overhead transparencies.

Multimedia Advantages

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3. Gains and Holds Attention

- ▶ People are more interested in multimedia messages, which combine the elements of text, audio, graphics and video.

Multimedia Advantages

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4. Good for "computer-phobics"

- ▶ Those who are intimidated by computer keyboards and complex instructions are more comfortable with pressing buttons with a mouse or on a screen

Multimedia Advantages

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5. Multimedia is Entertaining as Well as Educational

Multimedia Disadvantages

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1. Expensive
2. Not always easy to configure
3. Requires special hardware
4. Not always compatible

Multimedia

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TEXT



Content

- ▶ Definition of Text
- ▶ Text Elements
- ▶ Fonts
- ▶ Typefaces
- ▶ Fonts Effects
- ▶ Font Categories
- ▶ Kerning and Leading
- ▶ Considerations and guidelines when working with text
- ▶ Bitmapped and vector fonts
- ▶ Text Data Files
- ▶ Review Questions

Definition of Text

- ▶ Text is words and symbols in any form, spoken or written, are the most common system of communication.
- ▶ Text is used in most Multimedia applications.
- ▶ With multimedia technology, text can be combined with other media in a powerful and meaningful way to present information and express moods.
- ▶ Text is the easiest to manipulate.

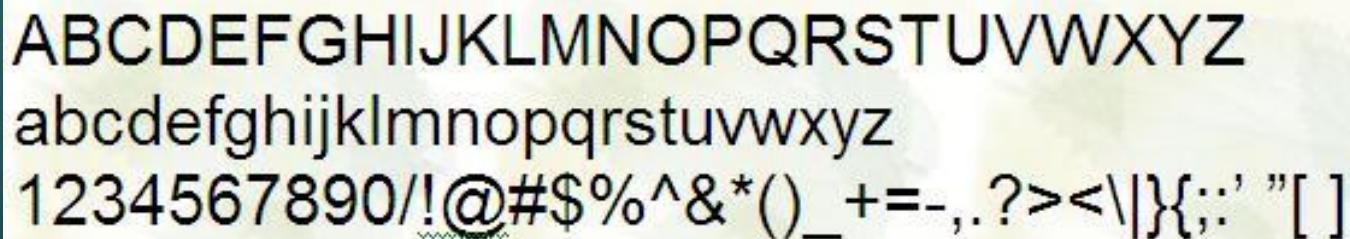
Text Elements

- ▶ Based on creating letters, numbers and special characters.
- ▶ Text elements can be categories into:
 - ▶ Alphabet characters : A - Z
 - ▶ Numbers : 0 - 9
 - ▶ Special characters : Punctuation [. , ; ‘ …] , Sign or Symbols [* & ^ % \$ £ ! ∕ ~ # @]
 - ▶ May also include special icon or drawing symbols, mathematical symbols, Greek Letter etc.

Fonts

- ▶ A ‘font’: is a collection of characters of a particular size and style belonging to a particular typeface family.
- ▶ Usually vary by type sizes and styles.
- ▶ The sizes are measured in points
- ▶ This includes the letter set, the number set, and all of the special character and diacritical marks you get by pressing the shift, option, or command/control keys.

Arial Fonts



ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890!@#\$%^&*()_+=-,.?><\|}{;:' "[]

Typefaces

- ▶ A ‘typeface’: is a family of graphic characters that usually includes many type sizes and styles.
- ▶ A typeface contains a series of fonts.
- ▶ For instance, Arial, Arial Black Arial Narrow and Arial Unicode MS are actually 4 fonts under the same family.

Arial Typefaces Family

Arial

Arial Black

Arial Narrow

Arial Unicode MS

Fonts Effects

- ▶ A numbers of effects that are useful for bringing viewer's attention to content:
 - Case: UPPER and lower letter
 - **Bold**, *Italic*, Underline, superscript or subscript
 - **Embossed** or Shadow
 - **Colours**
 - **Strikethrough**

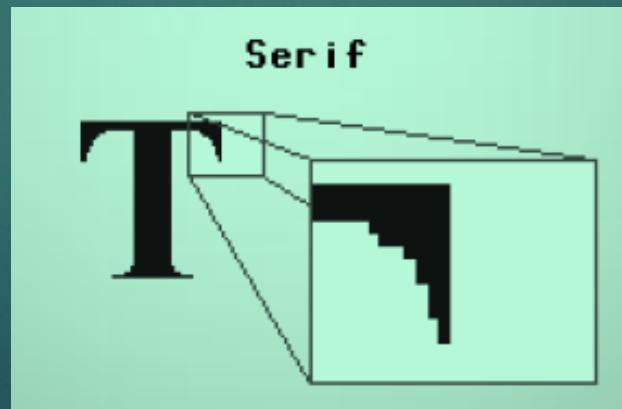
Font Categories

- ▶ Fonts can be characterized as
 - ▶ Serif
 - ▶ Sans serif
 - ▶ Decorative
- ▶ For computer displays, Sans Serif fonts considered better because of the sharper contrast.

Serif
Sans-Serif
Decorative

Font Categories -Serif

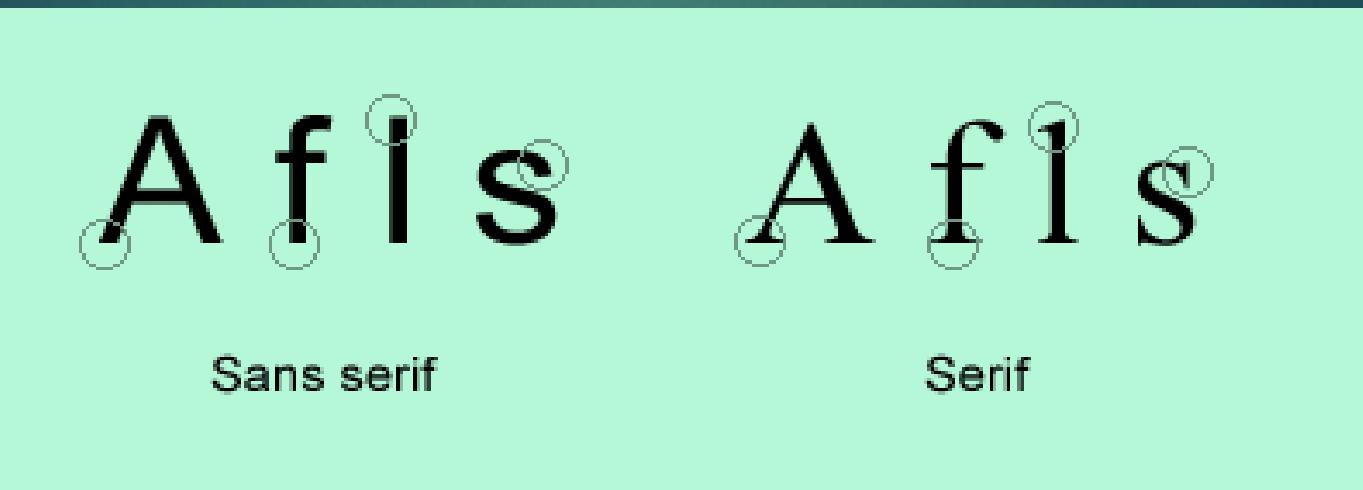
- ▶ Serif characters have a little "flag" or decoration at the end of the letter stroke.
- ▶ Serif fonts are usually used for documents or screens that have large quantities of text
 - ▶ This is because the serif helps guide the reader's eye along the text



Font Categories –San Serif

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- ▶ Sans Serif (sans is French for "without") characters don't have these decorations.



A f i s

Sans serif



A f i s

Serif

Font Categories –Decorative

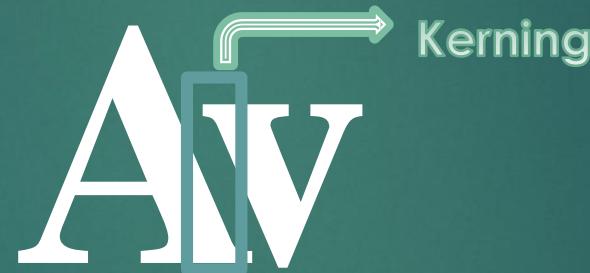
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- **Decorative typefaces:** are creative, and do well when you want to express certain emotions.
- It's easy to get overwhelmed looking at all the interesting decorative choices available. You might want to use many decorative fonts, but it's best to use them carefully.



Kerning and Leading

- ▶ **Kerning** is the spacing between character pairs
- ▶ **Leading** is the space between lines



Leading

Reading Line One

Reading Line Two

A large green bracket originates from the bottom left, pointing towards the word 'Leading'. Below it, the text 'Reading Line One' is displayed in a large, bold, white serif font. Below that, 'Reading Line Two' is also displayed in a similar large, bold, white serif font.

Working with Text

- ▶ Following are some **considerations** and **guidelines** to keep in mind when working with text :
- ▶ Be **Concise**
- ▶ Use **Appropriate Fonts**
- ▶ Make it **Readable**
- ▶ Consider **Type Styles** and **Colors**
- ▶ Use **Restraint** and be **Consistent**

Working with Text -Be Concise

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- ▶ Text should be kept to a minimum unless the application includes a great deal of reference material.
- ▶ Reading volumes of text on a computer screen is difficult and tiring.
- ▶ From a design standpoint, text should fill less than half the screen .

Working with Text -Use Appropriate Fonts

- ▶ Fonts are useful in focusing attention on **certain text** on the **screen**, enhancing readability, setting a tone (serious, lighthearted).
- ▶ When choosing a font, always consider the **objectives** and the **audience**.

INTERACTIVE MULTIMEDIA

Multimedia is the integration of any combination of text, graphics, animation, audio, and video into a dynamic, interactive presentation.

This may be appealing to a younger audience because their childlike or whimsical look.

INTERACTIVE MULTIMEDIA

Multimedia is the integration of any combination of text, graphics, animation, audio, and video into a dynamic, interactive presentation.

This are more appropriate for a formal look.

Working with Text -Make it Readable

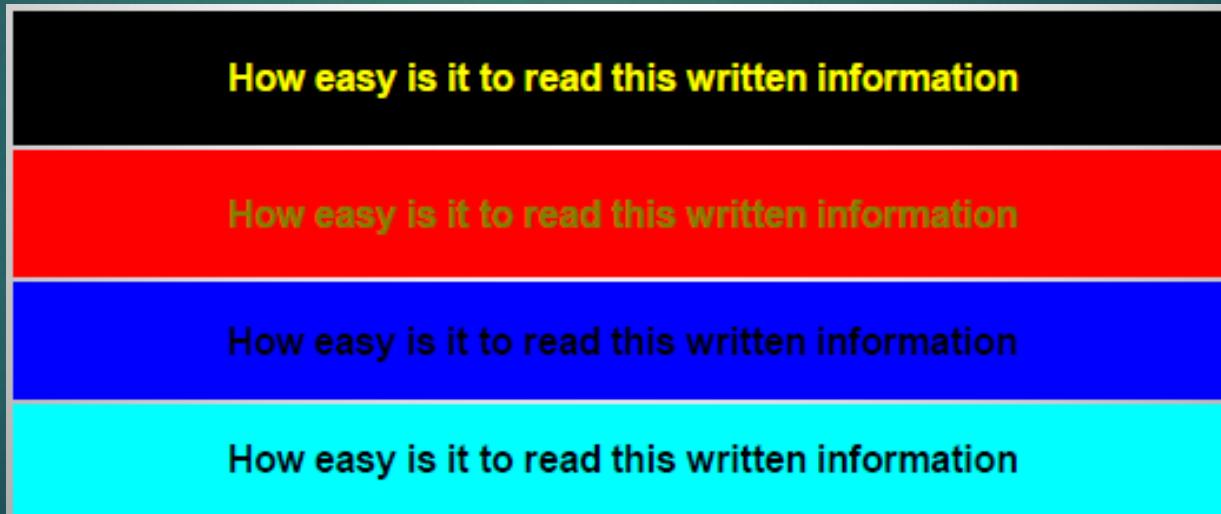
- ▶ Although a decorative font maybe attractive but it may also hard to read.
- ▶ The size of text depends on the application.
- ▶ Heading and subheadings are used to attract attention and provide the user with quick identification of the screen contents, while text blocks provide the material.

Headings	14 to 48 point
Subheadings	Half the heading size
Text blocks	10 to 12 point

Working with Text -Consider Type Styles and Colors

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- ▶ Three common type styles are **bold**, *italic*, and underline. These styles are often used for emphasis in print materials.
- ▶ Contrast between the **lettering** and background also is a very important factor in legibility and readability.



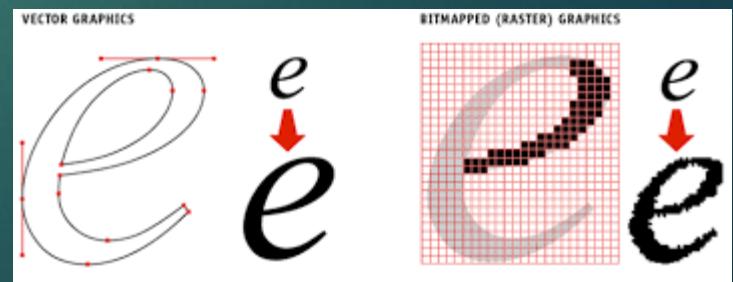
Working with Text -Use Restraint and be Consistent

- ▶ Although it may be tempting and certainly easy to use various typefaces, sizes, and styles, it is important to exercise restraint.
- ▶ Be careful to avoid a busy and difficult to read design resulting from too many fonts and type styles on one screen.
- ▶ In addition, try to maintain consistency in the use of text.

Bitmapped and vector fonts

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- ▶ Fonts can either be stored as bitmapped or vector graphics
- ▶ Bitmaps font depend to the size and the pixel numbers
 - File size increases as more sizes are added
- ▶ Vector fonts can draw any size by scaling the vector drawing primitives mathematically
 - ▶ - File size is much smaller than bitmaps
 - ▶ - TrueType and PostScript are vector font formats



- ▶ The common data encoding schemes for text are:
 - ▶ **Plain text** (ASCII) is text in an electronic format that can be read and interpreted by human.
 - ▶ **Rich text** is similar but it also embeds special control characters into the text to provide additional features.
 - ▶ **Hypertext** is an advance on rich text which allows the reader to jump to different sections within the document or even jump to a new document.

Plain text

This is plain text. It is readable by humans. It can contains numbers (01234) and punctuation (.,#@*&) since it uses the ASCII character set.

Rich text

This is **rich text**.
It is also readable by humans but contains additional tags which control the presentation of the text.

Hypertext

This is [hypertext](http://www.w3c.org/). It uses the rich text format shown above but adds the ability to hyperlink to other documents.



Review Questions

- ▶ What is meant by text and discuss its elements.
- ▶ Discuss the differences between font and typefaces.
- ▶ What is the difference between Kerning and Leading?
- ▶ Discuss the font categories.
- ▶ What are the differences between Bitmapped and vector fonts?
- ▶ What are the considerations and guidelines to keep in mind when working with text ?
- ▶ What are the common data encoding schemes for text?

Multimedia

3

GRAPHICS



Content

- ▶ Definition of Graphics
- ▶ Types of Graphic
 - ▶ Bitmap Graphics
 - ▶ Vector Graphics
- ▶ Resolution
 - ▶ Image Resolution
 - ▶ Display Resolution
 - ▶ Color Resolution
- ▶ Types of Images
- ▶ Binary Image
 - ▶ Grayscale Image
 - ▶ Color Image
 - ▶ RGBA / 32-bit images
- ▶ Digital Image File Formats
- ▶ Calculate Digital Image File Size
- ▶ Review Questions

Definition of Graphics

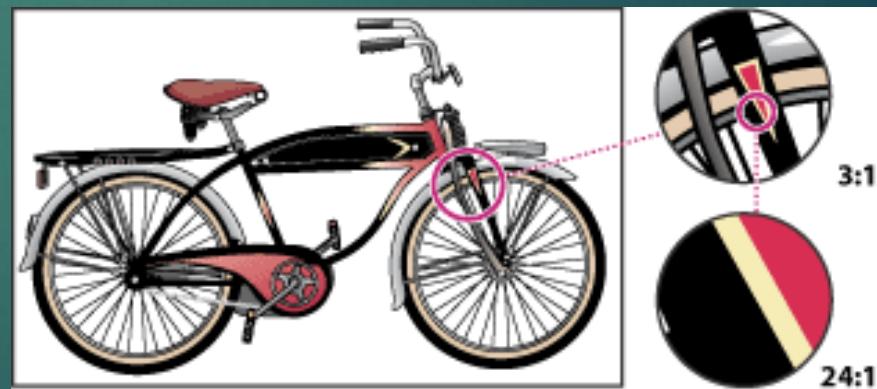
- ▶ **Image** is a spatial representation of an object or a scene.
(image of a person, place, object)
- ▶ Graphic is a broader and general definition which includes:
 - ▶ Pictures or Photographs
 - ▶ Drawings or Line arts
 - ▶ Clip arts
 - ▶ Buttons and Banner
 - ▶ Charts and graphs
 - ▶ Backgrounds
 - ▶ Icons

Types of Graphic

- ▶ Bitmap graphics



- ▶ Vector graphics



Bitmap Graphics

- ▶ The most common and comprehensive form of storage for images on computers is bitmap image.
- ▶ Bitmap use combination blocks of different colors (known as pixels) to represent an image. Each pixel is assigned a specific location and color value.
- ▶ There are also called panelized or raster graphics.
- ▶ Software to edit bitmapped graphics are :
 - ▶ Adobe Photoshop
 - ▶ Paint Shop Pro

Bitmap Graphics

► Advantage

- Can have different textures on the drawings; detailed and comprehensive(more real-looking).

► Disadvantage

- Large file size.
- Not easy to make modification to objects/drawings.
- Graphics become "blocky" when the size is increased.



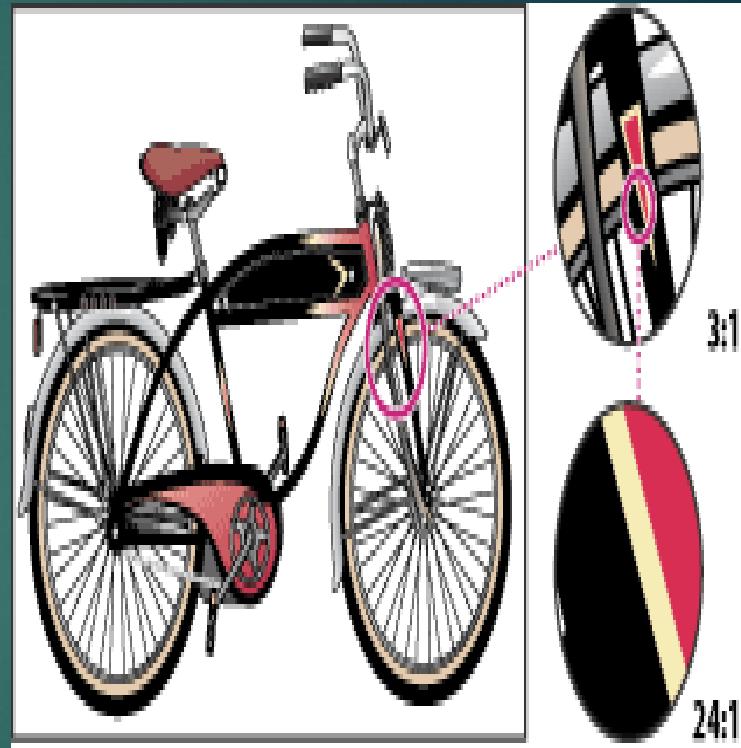
Vector Graphics

- ▶ Vector images are based on drawing elements/objects to create an image.
- ▶ The elements and objects are stored as a series of command that define the individual objects.
- ▶ Packages that allow to create vector graphics include :
 - ▶ Macromedia Freehand MX
 - ▶ Macromedia Flash MX
 - ▶ Adobe Illustrator

Vector Graphics

- ▶ Advantage
 - ▶ Small file size.
 - ▶ Maintain quality as the size of the graphics is increased.
 - ▶ Easy to edit the drawings as each object is independent of the other.

- ▶ Disadvantage
 - ▶ Objects/drawings cannot have texture; it can only have plain colors or gradients ; limited level of detail that can be presented in an image.



Resolution

- ▶ There are three types of resolution measuring different aspects of the quality, detail and size of an image:
 - ▶ **Image Resolution:** The term resolution often associated with an image's degree of detail or quality.
 - ▶ **Display Resolution:** Resolution can also refer to quality capability of graphic output (monitor).
 - ▶ **Color Resolution / Color Depth:** Color depth describe the number of bits used to represent the color of a single pixel.

Image Resolution

- ▶ Image resolution measures the pixel dimension of an overall image or how many pixels the image has.
- ▶ Image resolution is measured in width and height.
- ▶ For example, 100 * 100-pixel image has a total of 10,000 pixels.

Display Resolution

- ▶ Display resolution is also measured in pixels in terms of height and width.
- ▶ It simply means how many pixels can be displayed on the computer screen.
- ▶ Display resolution normally uses a setting of 640x480(VGA), 800x600 (SVGA), 1024x768, etc.
- ▶ You can change the display resolution under Display Properties in Control panel.
- ▶ If your image resolution is bigger than the display resolution, the result would be part of the image will be out of the display area.

Color Resolution/Color Depth

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- ▶ Each pixel can represent at least 2 possible colors or more.
- ▶ Color resolution or Color depth/channel depth is measured in bits.
- ▶ The file size of a bitmap image (in bytes):

Height X Width X (Color depth / 8)

Color Depth	Calculation	Number of Colors
1 bit	$2^1 = 2$	2 colors
4 bits	$2^4 = 16$	16 colors
8 bits (1 byte)	$2^8 = 256$	256 colors
16 bits (2 bytes)	$2^{16} = 65,536$	65,536 colors
24 bits (3 bytes)	$2^{24} = 16,777,216$	16,777,216 colors

Types of Images

- ▶ Binary Image
- ▶ Grayscale Image
- ▶ Color Image
- ▶ RGBA / 32-bit images

Binary Image

- ▶ These images have two possible values of pixel intensities: black and white.
- ▶ Also called 1-bit monochrome image, since it contains only black and white.
- ▶ Typical applications of binary images include office/business documents, handwritten text, line graphics, engineering graphics etc.
- ▶ The scanned output contains a sequence of black or white pixels. Binary 1 represents a black pixel and binary 0 represents a white pixel.



Grayscale Image

- ▶ They contain several shades of grey.
- ▶ Typical applications of grayscale images include newspaper photographs (non-color), magnetic resonance images.
- ▶ An uncompressed grayscale image can be represented by n bits per pixel, so the number of gray levels supported will be 2^n .
- ▶ For example, 8-bit Grayscale Image. It consists of 256 gray levels. A dark pixel might have a pixel value of 0, a bright one might be 255.



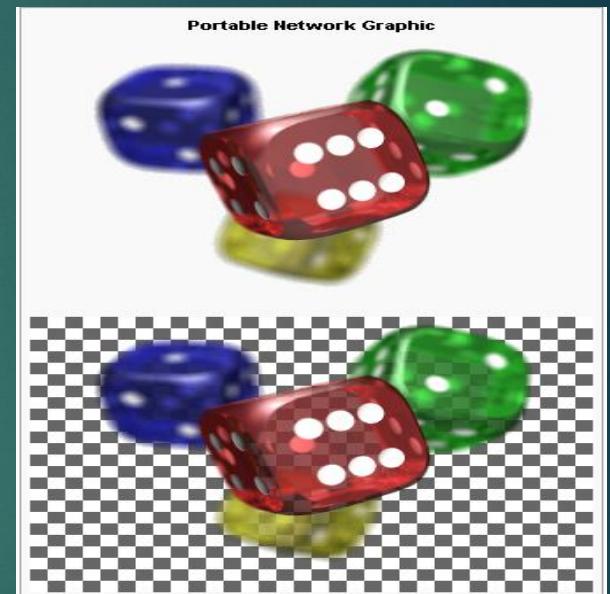
Color Image

- ▶ They are characterized by the intensity of three primary colors (RGB).
- ▶ For example, 24-bit image or 24 bits per pixel. There are 16,777,216 (2²⁴) possible colors. In other words, 8 bits for R(Red), 8 bits for G(Green), 8 bits for B(Blue).
- ▶ Since each value is in the range 0-255, this format supports 256 x 256 x 256 or 16,777,216 different colors.



RGBA / 32-bit images

- ▶ An important point: many 24-bit color images are actually stored as 32-bit images, with the extra byte of data for each.
- ▶ Allows RGBA color scheme; Red, Green, Blue, Alpha.
- ▶ Pixel used to store an alpha value representing the degree of “transparency”.



Digital Image File Formats

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File Name	Description
JPEG/JPG (Joint Photographers' Expert Group)	Most popular lossy image format. Allows users to specify what level of compression they desire.
PNG (Portable Network Graphics)	Best of lossless image formats. Widely supported across web. Allows you to include an alpha channel within file.
BMP (BitMaP)	Would avoid if possible. They offer little to no compression which results in unnecessarily large files.
TIFF/TIF (Tagged Image File Format)	Offers both compressed and uncompressed versions. Compressed are similar to PNG and uncompressed is similar to BMP.

Digital Image File Formats

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	Use	Don't Use
GIF	small graphics with limited color	photos
PNG	graphics and small files for web	photos for widespread use
JPEG	photos on the web	editing images
TIFF	editing and storage	online images

Calculate Digital Image File Size

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$$\text{File size (byte)} = \frac{(\text{height} \times \text{width} \times \text{color depth})}{8}$$

Example 1:

- ▶ A full screen graphic resolution (640 x 480 pixels) at an 8-bit color will yield the following file size:
- ▶ $(640 \times 480 \times 8) / 8 = 307200$ bytes

Example 2:

- ▶ A full screen graphic resolution (320 x 240 pixels) with 16-bit colors will yield the following file size:
- ▶ $(320 \times 240 \times 16) / 8 = 153600$ bytes

Review Questions

- ▶ Discuss the advantages and disadvantages of Bitmap graphics.
- ▶ Discuss the advantages and disadvantages of Vector Graphics.
- ▶ Discuss the different types of images
- ▶ What are the digital image file formats?

Multimedia

4

SOUND



Content

- ▶ Definition of Sound
- ▶ Characteristic of Sound Waves
 - ▶ Frequency
 - ▶ Amplitude
- ▶ Capture & Playback of Digital Audio
- ▶ Analogue to Digital Audio
- ▶ Digital Audio
- ▶ Quality Factors for Digital Audio File
- ▶ Digital Audio Types
 - ▶ Monophonic
 - ▶ Stereophonic
- ▶ Calculate Sound File Size
- ▶ Audio File Formats
- ▶ Musical Instrument Digital Interface (MIDI)
- ▶ MIDI Versus Digital Audio
- ▶ Data Rate & Bandwidth in Sample Audio Applications
- ▶ Advantages & Disadvantages of Using Audio
- ▶ Review Questions

Definition of Sound

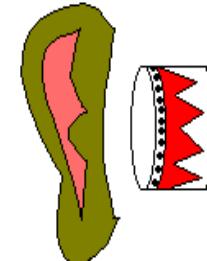
- ▶ Vibrations in the air create waves of pressure that are perceived as sound.
- ▶ Sound comprises the spoken word, voices, music and even noise.
- ▶ Sound waves vary in sound pressure level (amplitude) and in frequency or pitch.
- ▶ 'Acoustics' is the branch of physics that studies sound.
- ▶ Sound pressure levels (loudness or volume) are measured in decibels (dB).



Something vibrates
in the air



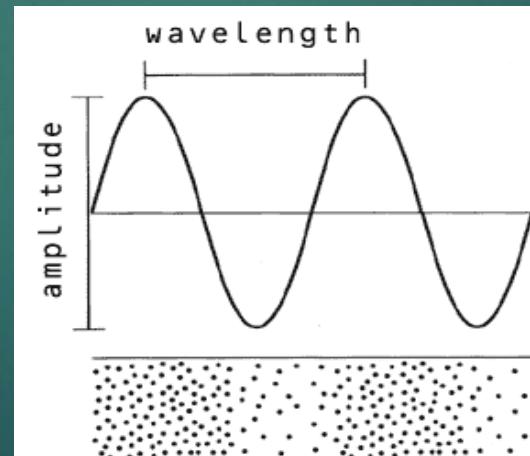
Waves of pressure



Ear drums will translate these
changes in wave Forms as sound

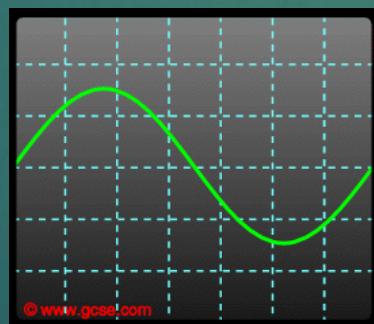
Characteristic of Sound Waves

- ▶ The unit of regularity is called a cycle. This is known as Hertz (or Hz)
 - ▶ One cycle = 1 Hz
 - ▶ Sometimes written as kHz or kiloHertz (1 kHz = 1000 Hz)
- ▶ Sound is described in terms of two characteristics:
 - ▶ Frequency (or pitch)
 - ▶ Amplitude (or loudness)

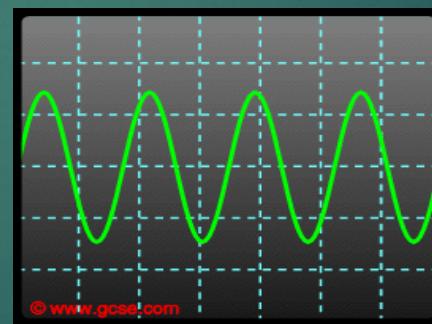


Frequency

- ▶ Frequency is a measure of **how many cycles occur** in one second. This is measured in Hertz (abbreviation Hz) and directly corresponds to the pitch of a sound.
- ▶ The more frequent vibration occurs the higher the pitch of the sound.
- ▶ Optimally, people can hear from **20 Hz** to 20,000 Hz (20 kHz)
 - ▶ Sounds below 20 Hz are infrasonic
 - ▶ sounds above 20 kHz are ultrasonic.



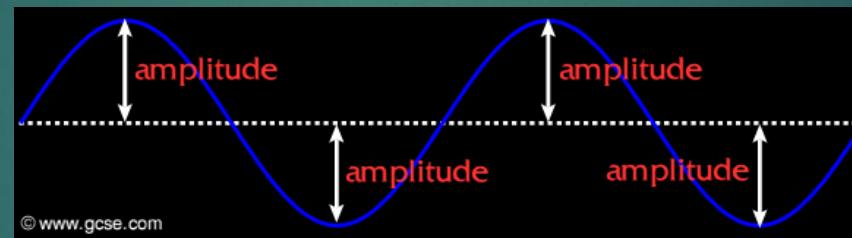
Low pitch



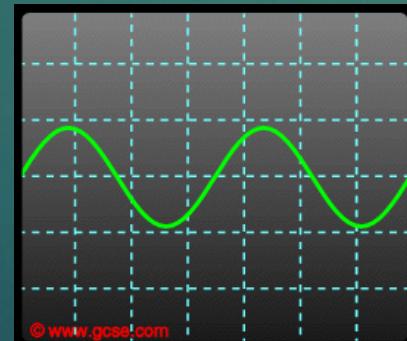
High pitch

Amplitude

- ▶ Amplitude is the maximum displacement of a wave from an equilibrium position.
- ▶ The louder a sound, the more energy it has. This means loud sounds have a large amplitude.
- ▶ The amplitude relates to how loud a sound is.

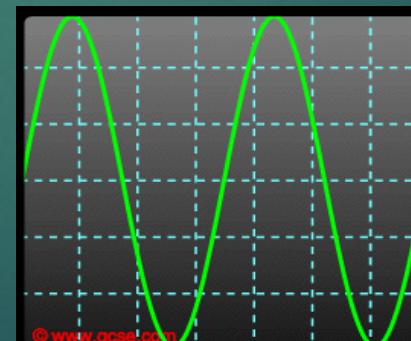


Quiet



Low amplitude

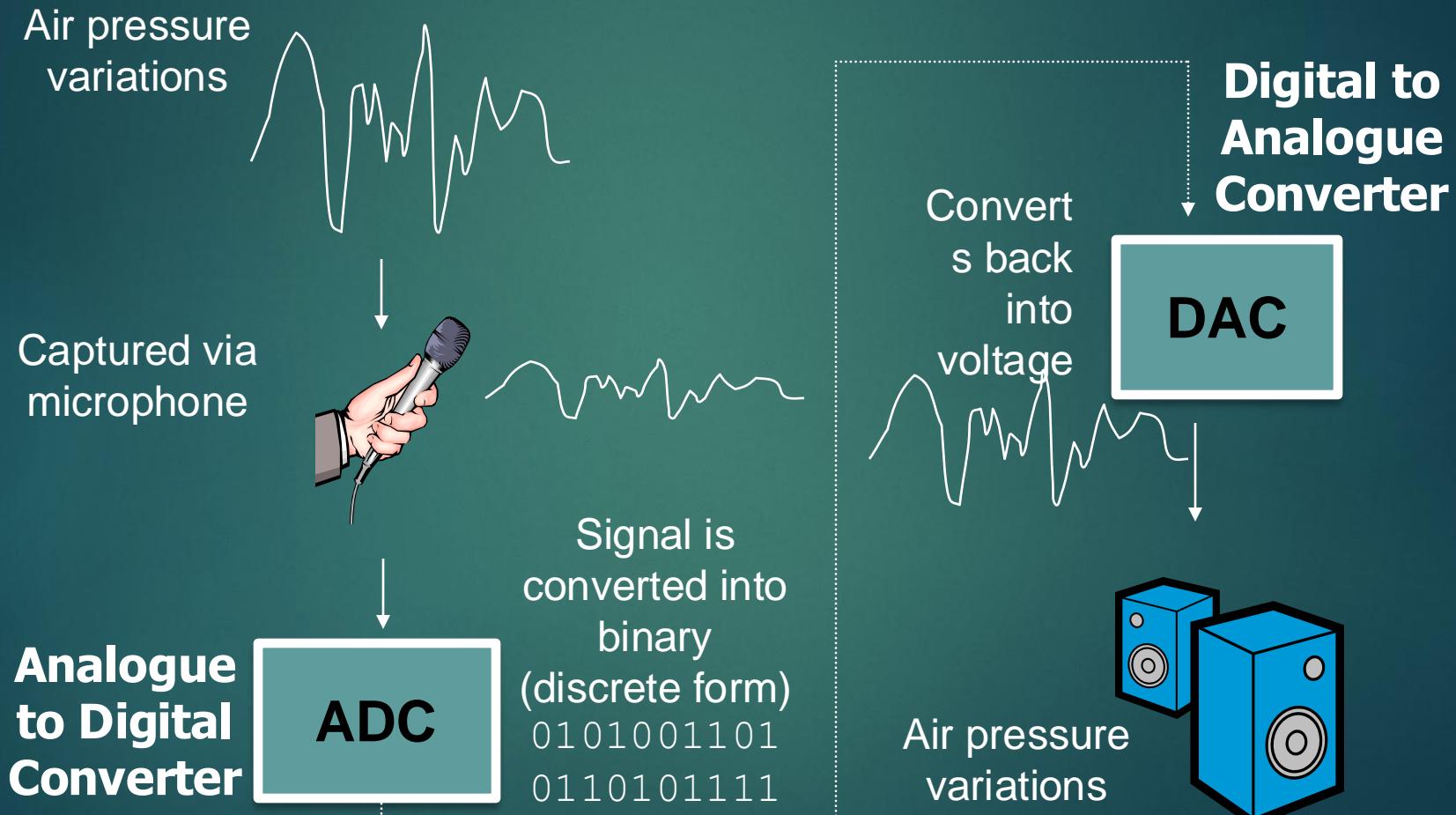
Loud



High Amplitude

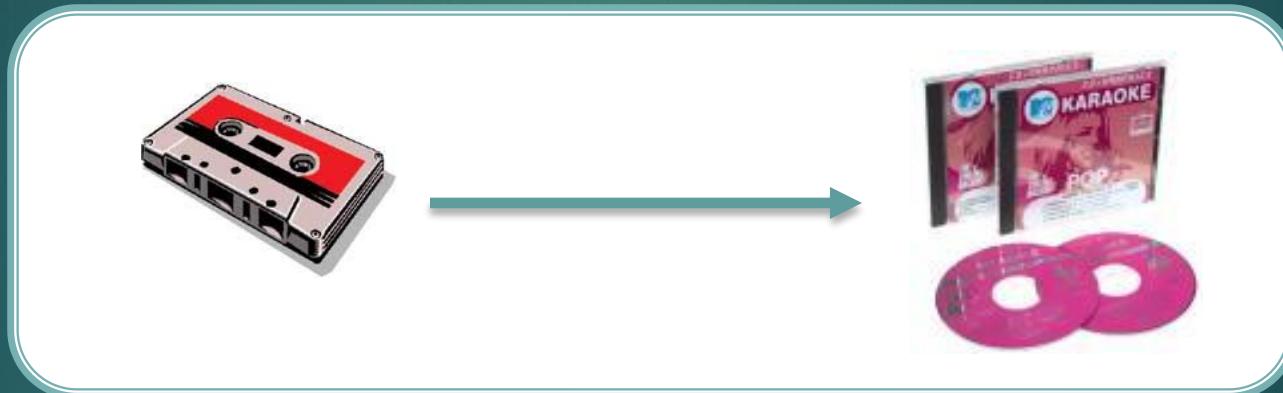
Capture & Playback of Digital Audio

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Analogue to Digital Audio

- ▶ Analogue audio
 - ▶ The name for an electronic signal that carries its information of sound as continuous fluctuating voltage value.
 - ▶ Stored in non digital tape or audio tape recording of sound.
- ▶ **Digitizing:** the process of converting an analog signal to a digital one.



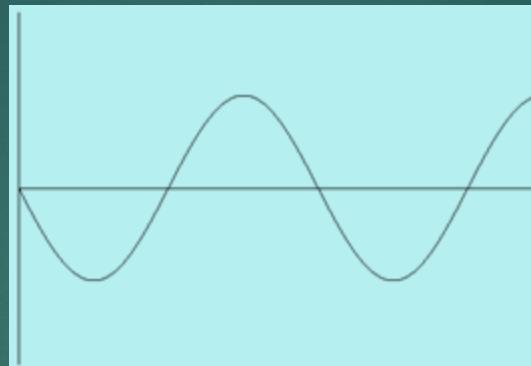
- ▶ A sound is recorded by making a measurement of the amplitude of the sound at regular intervals which are defined by the "sampling rate" (frequent of sample point taken).
- ▶ The process of taking the measurement is called "sampling" and each measurement is called a "sample point".

Digital Audio

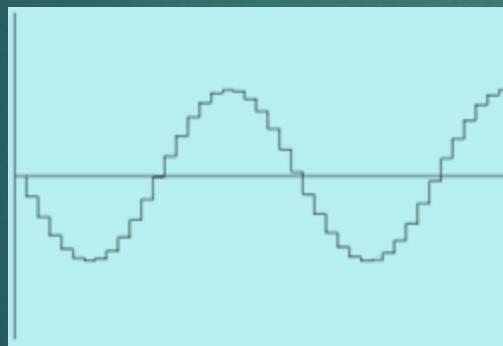
- ▶ Digital audio - data are stored in the form of samples point.
- ▶ Samples represent the amplitude (or loudness) of sound at a discrete point in time.
- ▶ Quality of digital recording depends on the sampling rate; the number of samples point taken per second (Hz).
- ▶ There are three sampling frequencies most often used in multimedia are 44.1 kHz, 22.05 kHz and 11.025 kHz.
 - ▶ The higher the sampling rate, the more the measurements are taken (better quality).
 - ▶ The lower the sampling rate, the lesser the measurements are taken (low quality).
- ▶ The number of bits used to describe the amplitude of sound wave when sampled, determines the sample size.

Digital Audio

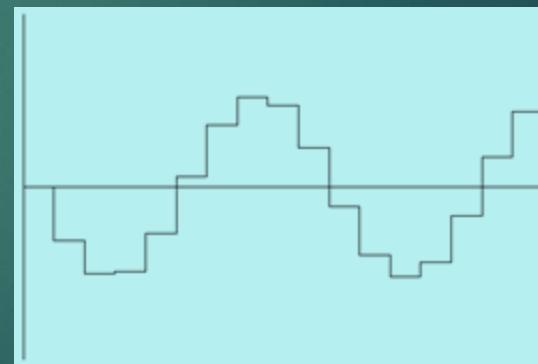
10



waveform



High Sampling Rate

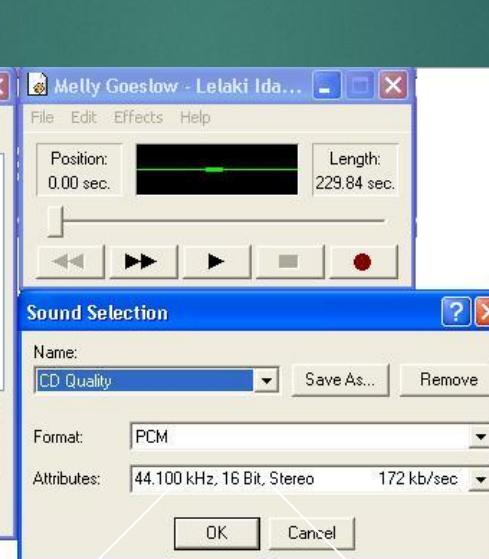
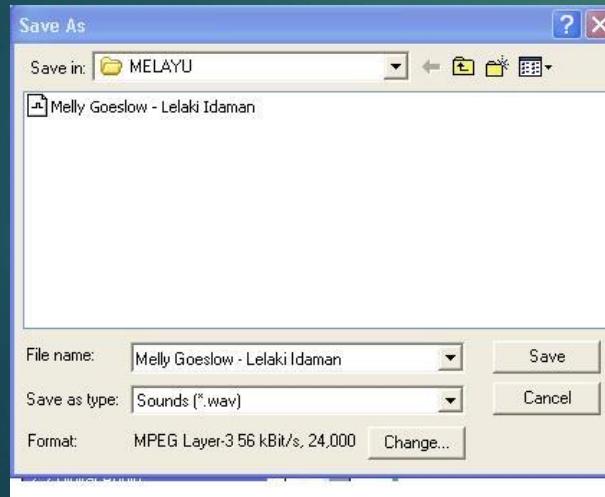


Low Sampling Rate

Quality Factors for Digital Audio File

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- ▶ Quality factors for digital audio file :
 - ▶ Sampling Rate : is the number of times the sample is taken.
 - ▶ Sample Size (resolution) : the number of bits used to record the value of a sample in a digitized signal.



Sampling Rate

Sample size

- ▶ Other than that, it also depends on:
 - ▶ The quality of original audio source.
 - ▶ The quality of capture device & supporting hardware.
 - ▶ The characteristics used for capture.
 - ▶ The capability of the playback environment.

Digital Audio Types

- ▶ Two types:
 - ▶ Monophonic
 - ▶ Stereophonic

Monophonic

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- ▶ Commonly called mono sound, mono, or non-stereo sound, this early sound system used a single channel of audio for sound output.
- ▶ Monophonic sound is the most basic format of sound output.
- ▶ Mono (monophonic, or monaural) is sound from a single source.
- ▶ All speakers in a mono system (like an intercom) will carry the same signal.

Stereophonic

- ▶ Commonly called stereo sound or just stereo, stereophonic sound divides sounds across two channels (recorded on two separate sources) then the recorded sounds are mixed so that some elements are channeled to the left and others to the right.
- ▶ Stereo (stereophonic) is sound from two sources, ideally spaced apart, and reproduces sound the way we hear it naturally, with two ears.

Calculate Sound File Size

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- ▶ Sound File Size = Sample rate x sample size x channel x duration

Calculate Sound File Size

- ▶ **Example 1:** Calculate how much storage space is needed to record a 16-bit, 44.1khz, stereo music for a duration of 30 seconds.

$$\begin{aligned}\text{Sound file size} &= 44100 \times 2 \times 2 \times 30 \\ &= 5292000 \text{ bytes}\end{aligned}$$

Calculate Sound File Size

- ▶ **Example 2:** Calculate how much storage space is needed to record a 8-bit, 11khz, mono sound for a duration of 10 seconds.

$$\begin{aligned}\text{Sound file size} &= 11000 \times 1 \times 1 \times 10 \\ &= 110000 \text{ bytes}\end{aligned}$$

Audio File Formats

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- Wav audio (.wav)
- MP3 audio (.mp3)
- AIFF (Audio Interchange File Format)
- Real audio (.ra, rm)
- MIDI (.mid)
- Windows Media (.wma)

Musical Instrument Digital Interface (MIDI)

- ▶ Before there was a wide use of mp3 and high bandwidth network, MIDI format audio is popular when an audio is required to be put on a website.
- ▶ Provides a standard and efficient, means of conveying musical performance information as electronic data.
- ▶ MIDI is a shorthand representation of music stored in numeric form.
- ▶ It is in the form of music score and not samples or recording. It is not digitized sound.
- ▶ Purposely for music
- ▶ A sequencer software and sound synthesizer is required in order to create MIDI scores.
- ▶ MIDI is device dependent.
- ▶ Since they are small, MIDI files embedded in web pages load and play promptly.
- ▶ Length of a MIDI file can be changed without affecting the pitch of the music or degrading audio quality.
- ▶ Working with MIDI requires knowledge of music theory.

- MIDI is analogous to structured or vector graphics, while digitized audio is analogous to bitmapped images.
- MIDI is device dependent while digitized audio is device independent.
- MIDI files are much smaller than digitized audio.
- MIDI files sound better than digital audio files when played on a high-quality MIDI device.
- With MIDI, it is difficult to playback spoken dialog, while digitized audio can do so with ease.
- MIDI does not have consistent playback quality while digital audio provides consistent playback quality.
- One requires knowledge of music theory in order to run MIDI, while digital audio does not have this requirement.

Data Rate & Bandwidth in Sample Audio Applications

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Quality	Sample Rate (Khz)	Bits per Sample	Mono / Stereo	Data Rate (uncompressed) (kB/sec)	Frequency Band (KHz)
Telephone	8	8	Mono	8	0.200-3.4
AM Radio	11.025	8	Mono	11.0	0.1-5.5
FM Radio	22.05	16	Stereo	88.2	0.02-11
CD	44.1	16	Stereo	176.4	0.005-20
DAT	48	16	Stereo	192.0	0.005-20
DVD Audio	192 (max)	24(max)	6 channels	1,200 (max)	0-96 (max)

Advantages & Disadvantages of Using Audio

Sound adds life to any multimedia application and plays important role in effective marketing presentations.

➤ Advantages

- Ensure **important information** is noticed.
- Add **interest**.
- Can communicate **more directly** than other media.

➤ Disadvantages

- Easily overused.
- Requires special equipment for quality production.
- Not as memorable as visual media.

Review Questions

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- ▶ Discuss the characteristics of sound waves.
- ▶ Discuss how to capture & playback of digital audio.
- ▶ Discuss the different types of digital audio.
- ▶ What are the digital audio file formats?
- ▶ Compare between MIDI and digital audio.
- ▶ What are the advantages & disadvantages of using audio?