# Introduction to Multimedia Applications CT801-4-0-IMA

Audio

ASIA PACIFIC UNIVERSITY
OF TECHNOLOGY & INNOVATION

# Topic & Structure of the lesson

- Introduction
- Audio Characteristics
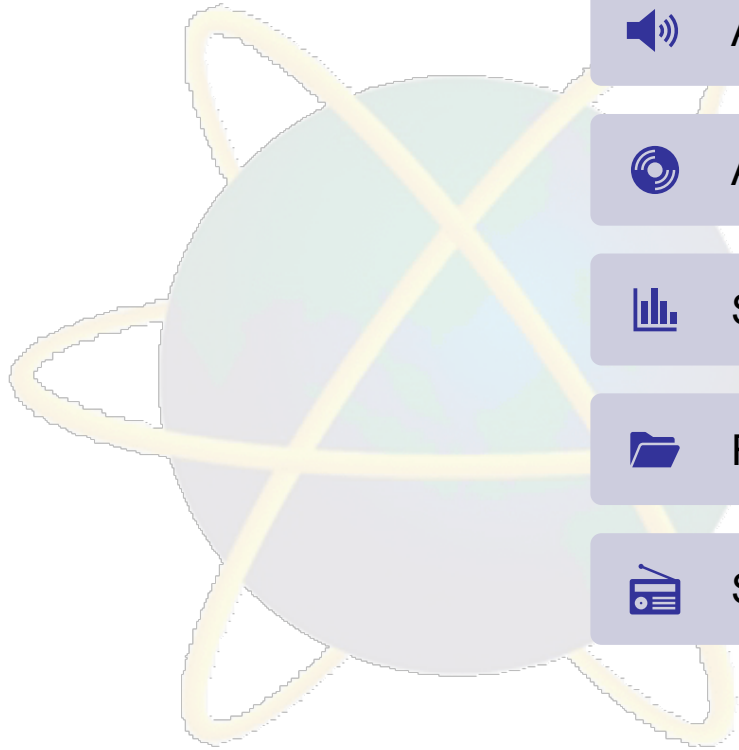- Audio Quality
- Audio File Formats
- Sampling Rate
- File Size Calculation
- Sound

# Learning Outcomes

**At the end of this lecture you will be able to:-**

Identify the different sound types and formats.
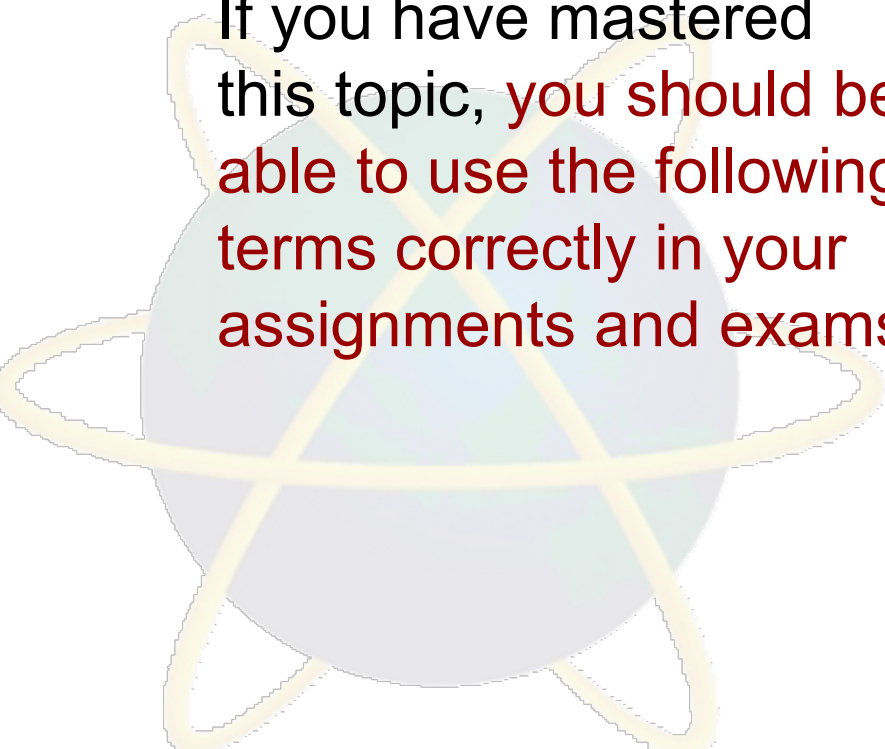
Considerations on sound digitalizing

Explain the sampling technology and concepts.

Calculate compress file sizes.

# Key Terms you must be able to use

If you have mastered this topic, you should be able to use the following terms correctly in your assignments and exams:

Audio

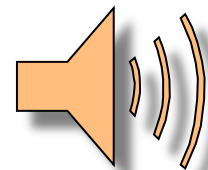Quantization

Sampling Rate

File Size

# Definition - Sound

Fluctuations in air pressure that can be perceived by our ears with some qualitative attribute

Produced by a source that creates vibration in the air

The pattern of oscillation is called a waveform

# Characteristics of Sound

## Frequency

The number of cycles a sound wave creates in one second (pitch)

A cycle is measured from one wave peak to another

Unit: Herts (Hz) or cycles per second (cps)

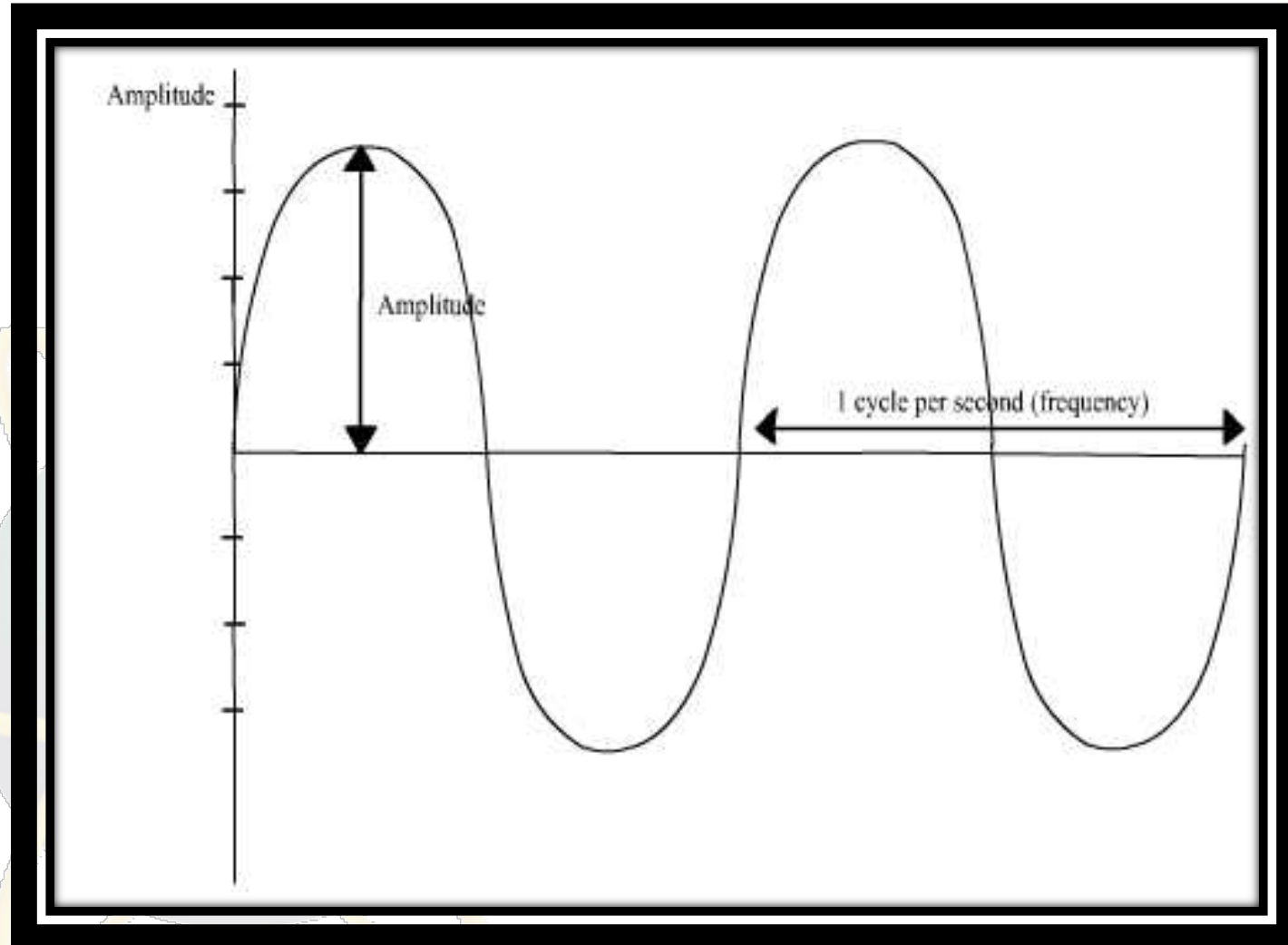## Amplitude

The volume or loudness of a particular sound

The louder the sound, the higher the amplitude will be

Unit: decibel (dB)

# Characteristics of Sound

# Types of sound

| | | |
|---|---|---|
| Sound effects | | Eg: door squeak, party crowd . |
| Message reinforcing | | Eg: when discussing topics on nature, sounds of birds, waves etc. can enhance the message |
| Music | | Produced by external devices |
| Narration | | A voice describes some facts that pertaining to the topic |
| Voice-overs | | Not to be confused with narration<br>Used in instances where short instructions may be necessary for the user to navigate the multimedia application. |
| Singing: | | Combines characteristics of speech and music |

# Sources of Audio

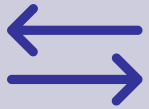Capture the sounds using a microphone

Record from radio

Connect to external MIDI devices such as an electric piano keyboard

Purchase audio clips on a CD-ROM or DVD-ROM

Download from the Internet
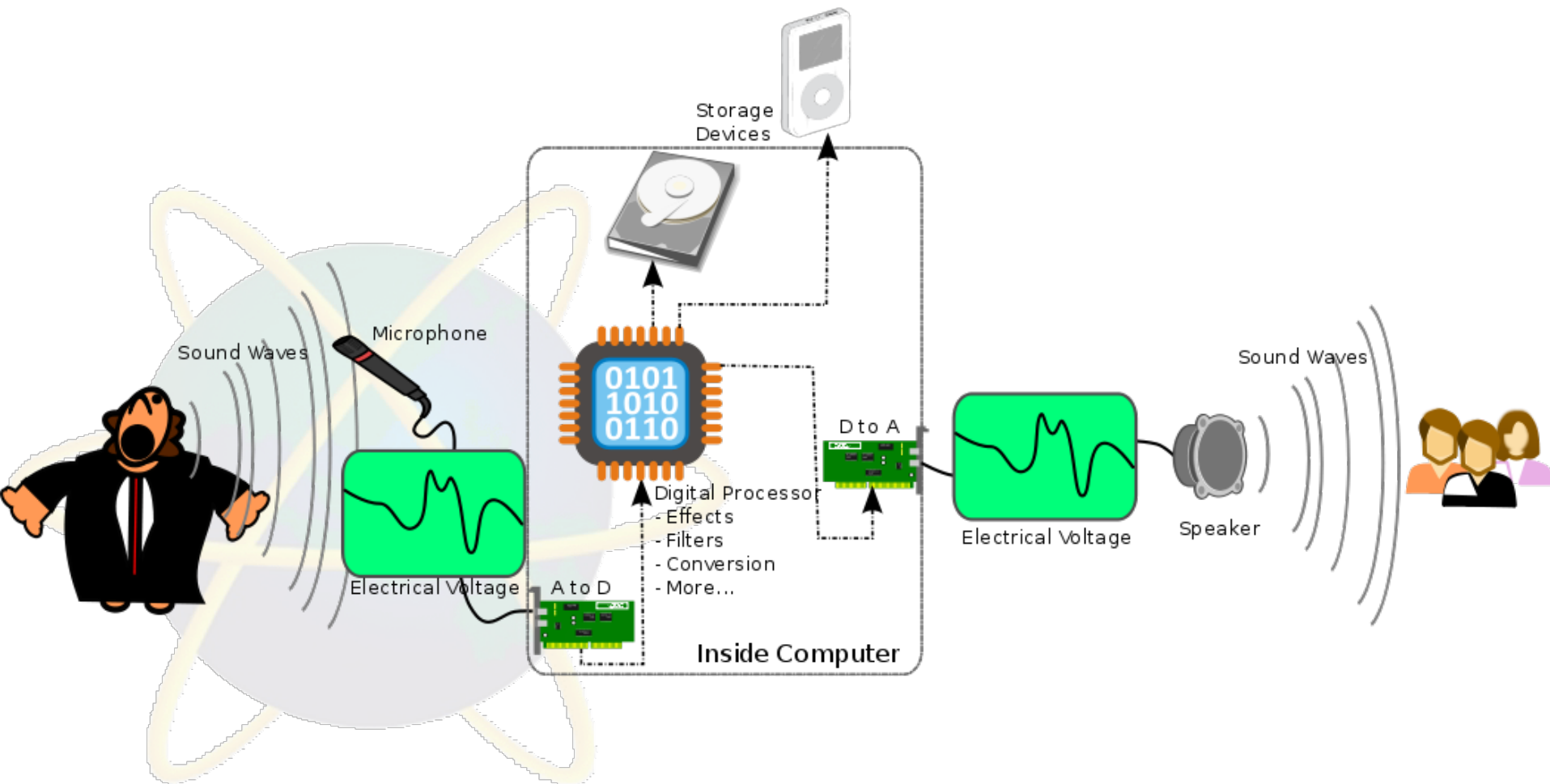
# Definition - Digitization

Our world and bodies are analog, functioning in a smooth and continuous flow (analog signal)

eg water current, wind, the flow of bloods etc.

The digital world is made of *little chunks* (digital signal)

# Digitization : Digital Signal

The representation of info as a series of numbers

↓

A sequence of discrete values coded in binary format

↓
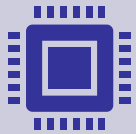
Humans deal with analog info

↓

Humans only perceive digital info when it has been transformed into analog domain

↓

Computer can only generate and accept info in digital form
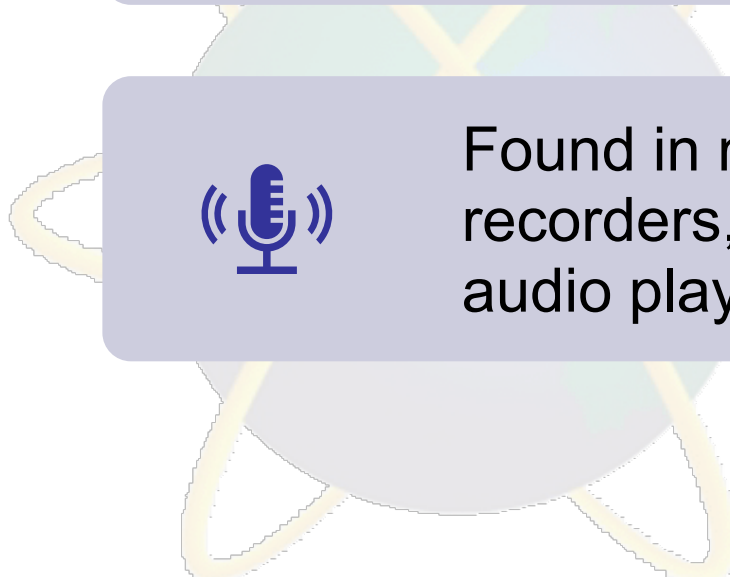
↓

Therefore, we need "Digitization"

# Digitization (Devices)

Two devices that allow human and computer interact: ADC and DAC

Found in mm hardware: sound card, audio recorders, graphic cards, video recorder, CD-audio players, printer, monitor, network card etc.

# ADC vs DAC

**Analogue-to-Digital Converter (ADC):**

Performs the process of converting from analog sound to digital sound

**Digital-to-Analog Converter (DAC):**

Performs the re-conversion back to analogue sound from digital sound

# Digitization (Process)

**Digitizing Sound**

Waveform
(analog sound)

Computer
Sound Card

01110011101

Stream of zeros and ones
(digital sound)

---

Digitization (The transformation of analog signals into digital signals) requires 2 successive steps:

- Sampling
- Quantisation (resolution)

What you need to consider when you digitize sound?

- Sampling Rate
- Bit per sample
- Mono vs. stereo

# Digitization (Process: Sampling)

## Sampling:

- The process of grabbing the sound into small increments.
- These small increments will later form a series of discrete values coded in binary format
- Sampling Rate: How often the sound is grabbed, The higher the sampling rate, the more parts are grabbed, the better quality of sound & bigger file size (Unit: kHz)
- Sampling Rate most often used are 22.05 KHz (most common), 44.1KHz (common for audio CD), and 11.025KHz

# Digitization (Process: Quantization)

## Quantization:

- The process of rounding off a continuous value horizontally so that it can be represented by a fixed no of binary bits
- Unit: bits (can use 8-bit, 16-bit and so on to quantize sound)
- The larger the bit, the better the sound, the larger the file size
- Eg : Making music mathematically perfect.

# Audio Quality: Optimal Sampling

Digital sound can *sound very bad* if the *sampling rate* is too low. Listen to the following examples:-

- <u>44kHz</u>    16-bit    CD quality
- <u>22kHz</u>    16-bit    Very good
- <u>22kHz</u>    8-bit    Often good enough
- <u>11kHz</u>    8-bit    Often good enough
- <u>11kHz</u>    6-bit    Game quality, just okay
- <u>11kHz</u>    4-bit    Game quality, just okay
- <u>11kHz</u>    2-bit    Rough - telephone quality

# Audio Quality: Mono vs Stereo

Sound can be recorded at mono or stereo recording

Mono recording involves taking samples and quantized values with only one channel (like using 1 mic)

Stereo recording involves 2 channels (like using 2 mics).

# Type of Audio

**For Graphic:**
- Bitmap graphic
- Vector Graphic

**For Audio:**
- WAV audio (also named as Digitized Sound)
- MIDI audio (also named as Synthesized Sounds)

# Type of Audio (WAV)

A type of recording

Actual representation of a sound

Thru digitization process (sampling and Quantization)

Recorded from a microphone, tape recordings, etc

File size huge – require compression

Independent of playback system – quality always good

Suitable for voice

Software: Sound Forge

Eg : *.wav, *.mp3 etc.

# Type of Audio (MIDI)

**Music Instrument Interface**

**A set of instruction or notes telling how to produce the sound, what instrument will play these notes, when music start, when music stop, the volume etc.**

**Not the recording sound recorded thru mic**

**Not actual sounds**

**Generated using musical instruments like Synthesizer**

**Not involving digitization process (sampling and Quantization)**

# Type of Audio (MIDI)

File size small, especially suitable when not enough RAM, disk space, or CPU power

Can not store voice

When MIDI data or message is sent to a MIDI playback device, result is sound

It allows music and sound synthesizer from different manufacturers to communicate with each other by sending messages along cables connected to the devices.Eg:

- .mid, .rmi - synthesized audio based on MIDI standard
- .mod, .stm - like MIDI on steroids; rarely used in mm

# Sound Processing Software

| | | |
|---|---|---|
| Adobe Audition | Audacity | SoundEdit 16 |
| Deck II | Wave Studio | Sound Forge |

# Audio File Formats

.wav (Windows)

.aiff (Macintosh)

.mp3 (MPEG audio layer 3)

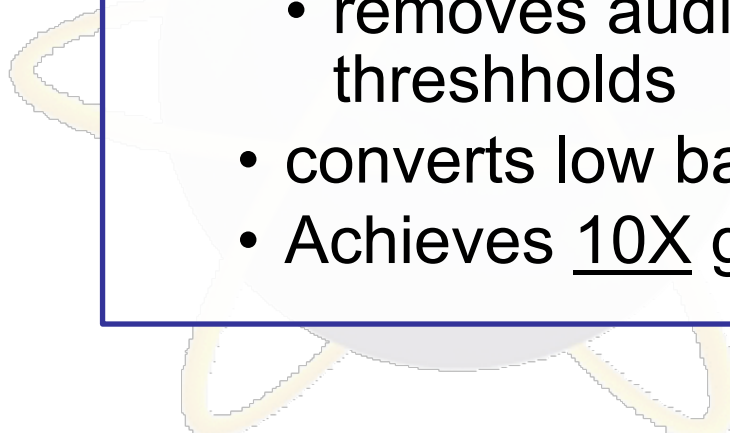.wma (Windows media audio)

.asf

.au (UNIX)

.aiff (Amiga)

# Audio File Formats - MP3

## MP3

- most complex coding scheme for MPEG audio
  - uses "perceptual coding"
  - based on what the human ear can hear
  - removes faint "unperceived" sounds
  - removes audio outside of frequency threshholds
- converts low bass to mono
- Achieves <u>10X</u> greater compression
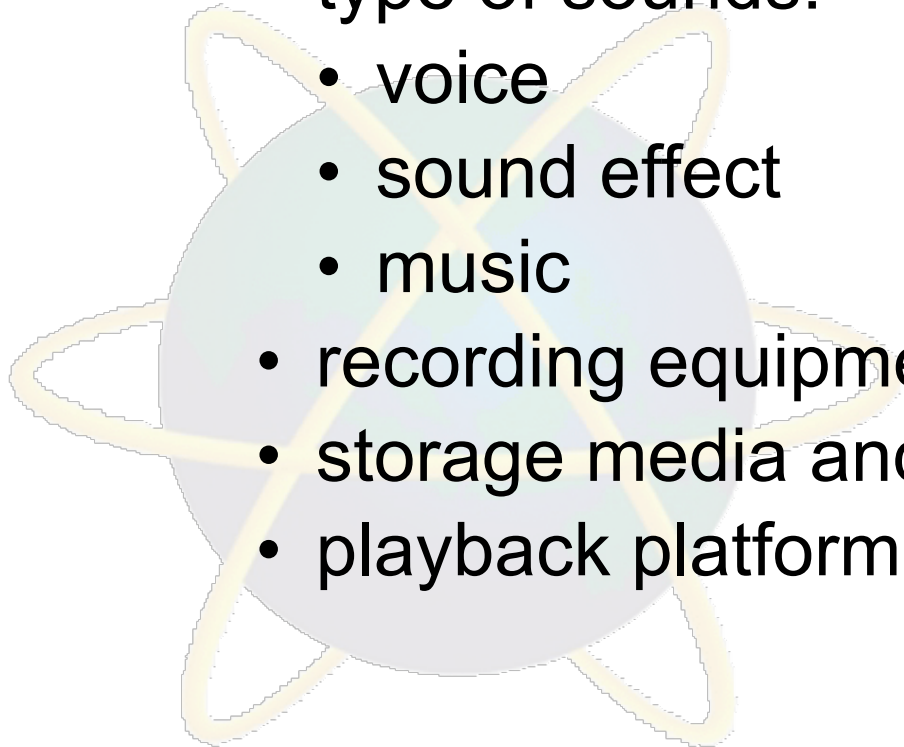
# Level of quality

## Decision on level of quality based on:

- type of sounds:
  - voice
  - sound effect
  - music
- recording equipment quality
- storage media and space
- playback platform

# File Size Calculation

To estimate the size of a digital sound in bytes, use the following formula:

- Sampling rate (Hz) X duration of recording (seconds) X quantization or resolution (bits) X types of channel ( 1 for mono and 2 for stereo)

What is the audio file size ?

- 16 bit audio, 44.1KHz, stereo shown for 3 seconds,

44100 X 16 X 3 X 2 =4233600 bits

# Quick Review Question

## 01
Define the term audio

## 02
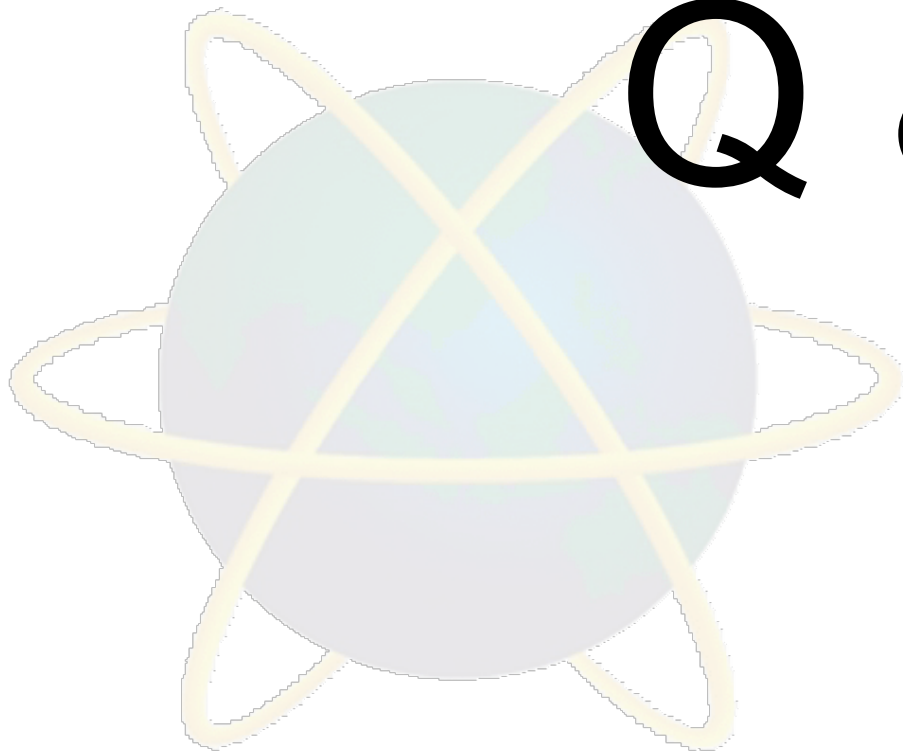Identify and explain 2 categories of animation

## 03
List the 2 types of audio

# Question and Answer Session

# Q & A

# Next Session

# Video