# MULTIMEDIA SYSTEM
# BITM 1113
# **Multimedia System**
# **SOUND**

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# Objectives:

At the end of the lecture, students would get to:

- ✓Understand the sound basic concept (principles).
- ✓Know the different between frequency, amplitude, pitch and loudness.
- ✓Differentiating analog and digital audio.
- ✓Knowledge on MIDI and wav.

# Introduction

- Sound may be the highest sensuous multimedia element.
- It have meaningful “speech” in any form of language, from whispering to a screaming.
- The way we use the power of sound can differ to ordinary presentation of multimedia and a professional spectacular.
- The wrong use of sound can actually give bad effect to our project.

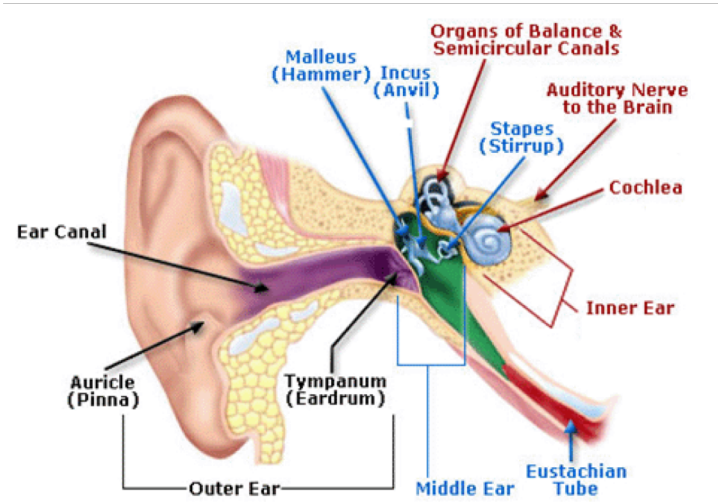
- All waves of sound are in analog form of nature, made up from unbroken continuous line without individual distinguishable piece or component forming the sound wave.
- It is opposite to digital signals, which break the sound wave into several individual component that approximately or mimic the wave shape.
- All other media are primarily visual, on the other hand sound is perceived along with different hearing sense.
- It is a complex mixture of physical and psychological factor where it is difficult to do accurate model.

# Sound Wave

- The sound wave pattern normally display as a 2Dimensional pressure graph or amplitude against time.
- For periodic waveforms, one *cycle* or *period* define the waveforms.
- Also known as **sound pressure function**, particularly digital representation.
- Digital sound is a sound that already being converted to or created (synthesized) in a discrete form (numeric values) suitable for storage and computer process.

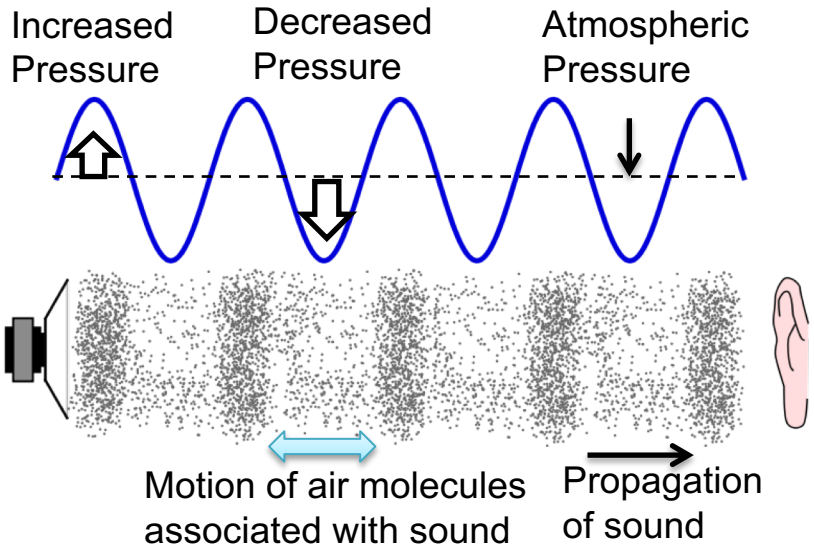
# Principles of Sound

- Sound can be best defined as oscillation (hayunan, buaian, getaran) of air pressure that stimulate the eardrum to the auditory nerve and the brain.
- The oscillation should occur in a range of frequency and amplitude.
- The hearing range of the average person is approximately 20Hz to 17KHz.

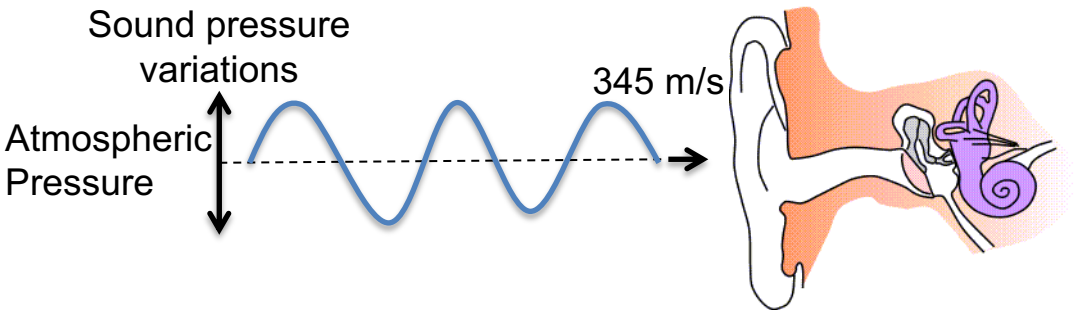


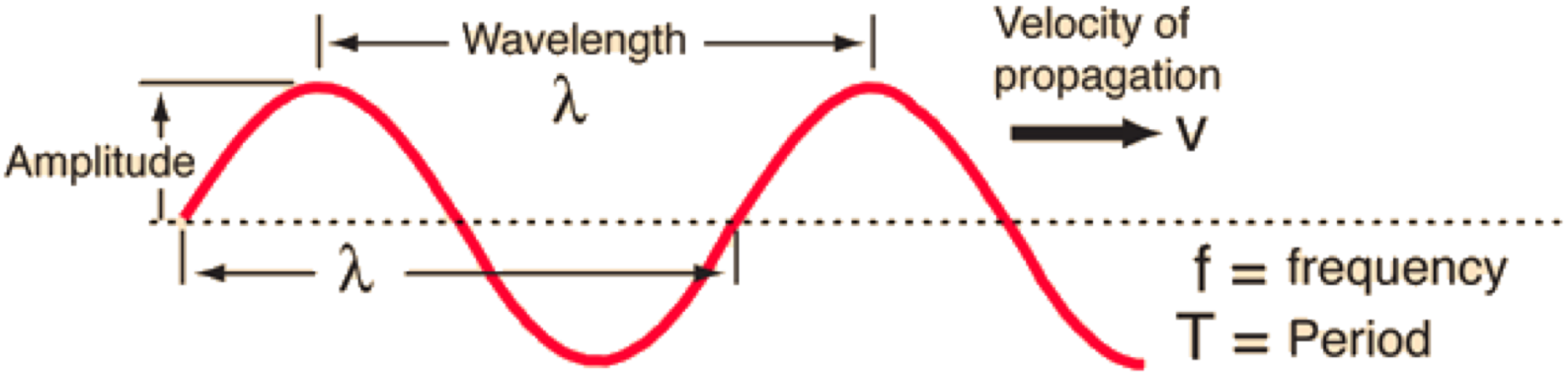
# Sound waves in air

- One frequency sound wave that travel through air will make a variation  air pressure variation.
- The air motion which accompany these passage of the sound waves will go back and forth in propagation of the sound direction.



- Creating a pendulum resemble the idea of tuning fork.
- The main receptors of sound would be the human ear.
- The eardrum form a membrane that connect to a body of liquid and is very sensitive to changes of pressure with certain wavelength.
- The change of pressure give hydraulic action that has been convert into the electrical signal ultimately interpreted as sound by the brain.






- Sound wave's ***amplitude*** = sound's intensity
- Sound wave's ***frequency*** = the length of time taken for the wave to complete one entire cycle

Measured in unit **Hertz (a cycle per second)**

**1000 Hertz = 1 KHz = 1000 cycle per second**

# Frequency

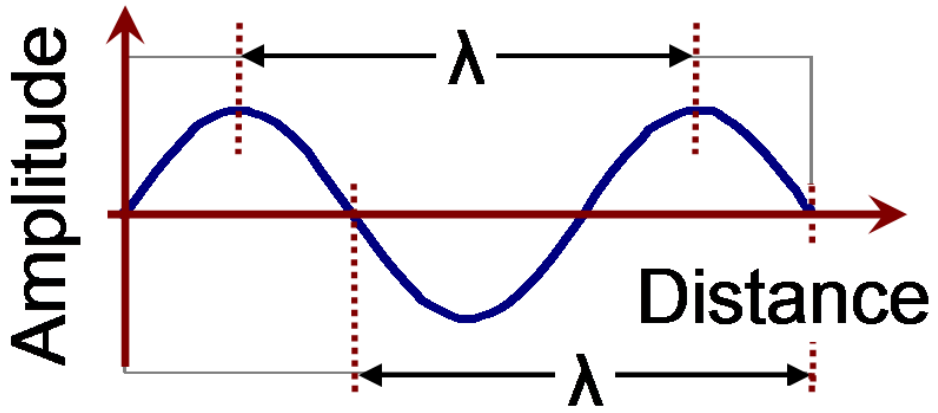
- The period reciprocal value represent the number of period in a seconds and measure in hertz (Hz) stand for a cycles per second (cps).

  **[ 1 HZ = 1 cycle per second ]**

- Determine by the time length it take the wave to complete a single complete cycle.
- Single cycle is when the wave go up, down through the line and goes up again to the start point.
- In Multimedia systems - make use of sound only within the frequency range of human hearing - audio (acoustic signals) - speech, music and noise (range between 20Hz to 20kHz).
- Every musical note has a related hertz value.

# Amplitude

- The amplitude is the intensity or loudness of sound.
- The displacement measure of the air pressure wave from its mean or rest position.
- It is related to the distance above and below the centerline the wave of sound.
- The center line is the horizontal line in the drawings below, it is zero degrees.



# Psychology of Hearing

- The frequency properties and amplitude have corresponding concept in auditory perception: pitch and loudness.
- **Pitch**: sound pitch depend on the sound frequency. The higher the frequency, the greater the pitch and vice versa.
- It is the pitch of sounds that allow us to distinguished between a sound of boy and girl or woman and cat.
- Etc. sound of a woman is ***shrill*** due to high pitch. Sound of a dog is grave due to low pitch and low frequency.

# Pitch

- The subjective frequency impression in the same sense that loudness is the subjective sense of the sound amplitude.
- The pitch that perceived of a sound is the response of ear to the frequency.
- Pitch is a psycho acoustic variable, and the sensitivity degree shown to it varies widely with peoples.
- The tone pitch or note allow it to be put in a musical scale; thus notes of a scale are generally called pitches, and given names (A, B, C, C#, do, re, mi, etc.).

- **Loudness**: Corresponds roughly to the note amplitude.
- The frequency and amplitude of the physical stimulus are both depend by the perceived sound loudness.
- Loudness is measured in decibels (dB).
- The smallest audible sound is 0dB. A sound 10 times more powerful is 10dB. The table show common sounds and its decibel rating:

| Decibel | DESCRIPTION |
|---|---|
| 140 dB | A gunshot or fire cracker |
| 120 Db | A rock concert or a jet engine |
| 110 dB | A car horn |
| 90 dB | A lawnmower |
| 60 dB | Normal conversation |
| 15 dB | A whisper |
| 0 dB | Near total silence |

# Loudness

- The ears of human measure the distances the eardrum move when human hear a sound. The message is received by the brain.
- The brain translate the amplitude into the sound loudness.
- Loud sounds have a huge amplitude. They make the ear drum vibrate very far.
- Soft sound have a small amplitude. They vibrate the ear drum the least.
- When the vibration is too small or too large, a person can’t hear the sound.

# Digital Audio

- The compact disc (CD) is the most common digital form audio.
- Analog waveform digitized involve break it up into many tiny piece that can be line up together to form a close approximation of the origin and continuously signal.
- The more sample is  take, the more piece is used to recreating the signal result in a greater signal of resolution.
- Digital audio are good quality signal that suffers from very few distortion and noise than analog signas.

# Analog to Digital Converter (ADC)

- Electronic equipment use to make changes and converting an analog signal to a digital signal (made up of 1sec and 0sec)
- The converter of analog to digital is to obtain the waveform (the analog signal) and break it into the thousand of small "stairs" that simulating the wave
- Analog signal is convert to digital signal for a lot of reason and also to improve the power process, to encode analog signal for later playback with a digital medium (CD and DVD) etc.

# Why is it important to change from analog to digital?

- Computer is in digital format.
- To get more clear, precise audio with less noise.
- Noise can be cut / reduced by using digital. (can be edit).
- Quality of data when transmitted – especially for long distance transmission.

# Audio Terms

| Sampling Rate | Sampling Size | Quantization | Clipping |
|---|---|---|---|
| ❖ Describes how often samples are taken<br><br>❖ Every *n*th fraction of a second, a sample of sound is take and store as bits & bytes of digital information<br><br>❖ 3 sampling frequencies most frequent use in multimedia are CD quality 44.1 kHz, 22.05 kHz and 11.025 kHz. | ❖ The amount of information stored about each sample.<br><br>❖ The more frequent a sample is taken and the more data store about the sample, the better the resolution and captured sound in the play back quality is improve.<br><br>❖ Sample size are 8 bits or 16 bits. | ❖ The process of converting the sample amplitude to bits of data<br><br>❖ Value of each sample is rounded off to the nearest integer<br><br>❖ It can produce an unwanted background hissing sound. | ❖ If the amplitude is higher than the interval available, clipping of the top and bottom of the wave occurs.<br><br>❖ Clipping may severely distort the sound. |

# Digital to Analog Converter (DAC)

- Electronic devices that decode digital data (one and zero) into an analog waveform electrical signal.
- Digital signal from format such as CDs and DVDs are converted from its digital form into an analog form to enable the amplifier and speaker to recreating the sound.
- Almost all digital playback device (CD, DVD, laserdisc, etc.) have a digital-to-analog converter.

# Editing Digitized Sound

- A number of software application are designed especially for digital sound editing and modification.
- Software that can be used to edit digital sound :
  - Sound Edit
  - SoundForge
  - Adobe Audition
  - Real Audio Encoder
  - Cybersound Sound FX
  - Camps
  - MidiScan
  - Webtracks

# File Size VS Quality

- Rate of sampling determine the frequency make up of the recording
- Sampling at greater rate are more accurate captures the high frequencies content of the sound
- Use more bits produce a recording that sound more like the its origin.
- Stereo recording are more lifelike and realistic since a person got two ears.
- Mono recording is good but would sound a bit of “flat” & not so interesting when compare to stereo recording.
- Stereo sound file require two times storage space as mono files for the same time length.

- Sound files can be edited in a large number of ways :
  - Amplitude adjusted
  - Echo effect can be added
  - Pitch can be shifted
  - Various filters can be applied
  - Softening / Sharpening the quality of the sound
  - Trimming / combining and rearranging clips

# Common Audio Formats

| File Format | Description |
|---|---|
| ACC | Advanced Audio Coding (same with MP3) is a digital audio format used for high compression and high quality audio. |
| Audible 2, 3 and 4 | Audio file format (.aa file extension) use for audios book or other voices recording. All book can be store in one file. |
| AVI | Audio Video Interleaved is a Windows movie file with good video quality, however it is a huge file size. Approximately 25 GB is required for 60 minute video. |
| MP3 | MPEG 1 Audio Layer 3 is a digital audio format that is design for high compression of audio files while maintain the high audio quality. |
| MP3 VBR | MP3 using Variable Bit Rate that provide much more good quality and smaller files. |
| AIFF | Audio Interchange File Format similar to WAV. AIFF provides original sound quality and large file size. |
| WAV | Wave provides the same file sound quality and large file size as the original CD. |
| Ogg | Audio compression format, compared to other format use to store & play digital music, but its free of charge, open and unpatented. It use Vorbis, an audio compression scheme that's design to be in Ogg. |
| RAM / RA / RM | Real Audio is a proprietary format, and is used for streaming audio that enables you to play digital audio files in real-time. To use this type of file you must have RealPlayer (for Windows or Mac), which you can download for free. Real Audio was developed by RealNetworks. |

# Adding Sound to Your Multimedia Project

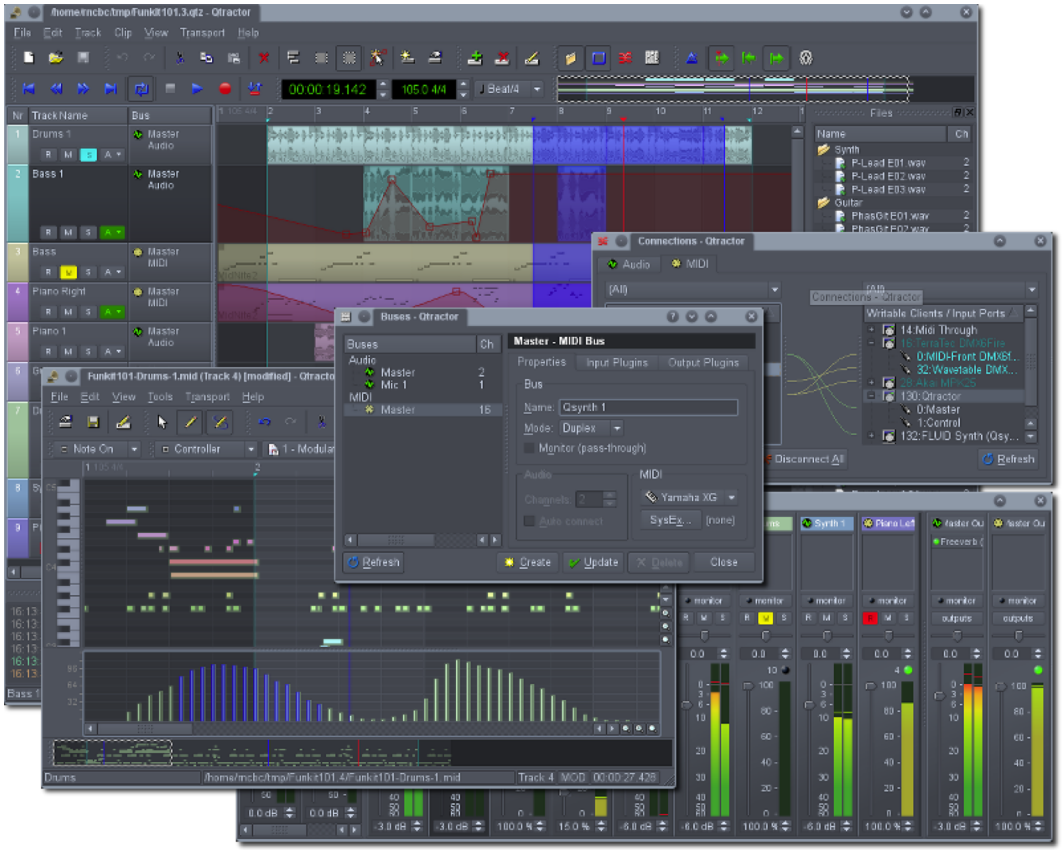
1. Deciding what sort of sound is need (like music background, special sound effect and voice over). Deciding where the audio event will go into the flow of the projects.
2. Fit the cues of sound in the storyboard, or make a cue sheet.
3. Deciding where & when to use digital audio or MIDI data.
4. Acquire sources of material by create it from start or purchase it. (copyright issue).
5. Alter the sound to suitable the project.
6. Do sound testing to ensure it properly timed along with the project's image.

# MIDI
# (Musical Instrument Digital Interface)

- **MIDI** is a standard for specify a performance in musical.
- Instead of sending a raw digital audio, it sends ***instructions*** to musical instruments to tell them what note to run, at what volume level, using which sound, etc.
- The ***synthesiser*** that receive the MIDI events is responsible for generate the actual sounds. Example: Keyboard Piano.

# MIDI SEQUENCERS

- A **MIDI sequencer** allows musicians to edit and create musical compositions like a word processor
  - Cut and paste
  - Insert / delete



# MIDI vs WAV

- MIDI is **NOT** digital sound…
- Quality recording, MIDI depend to the tools.
- Audio .wav easier to create compare than MIDI.

- **MIDI Advantages**
  - File Size small
  - Size Storage also small

- **MIDI Disadvantages**
  - Playback
  - Cost and Skill

# END OF LECTURE . . .

# Q & A ???