Introduction to Multimedia

Chapter 3
Audio

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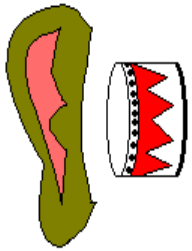
What is SOUND?

- Sound comprises the spoken word, voices, music and even noise.
- It is a complex relationship involving:
  - a **vibrating object** (sound source)
  - a **transmission medium** (usually air)
  - a **receiver** (ear) and;
  - a **preceptor** (brain).

The Power of Sound

Something vibrates in the air

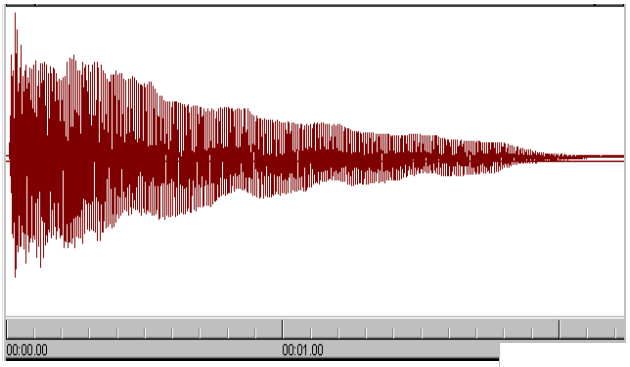
Waves of pressure



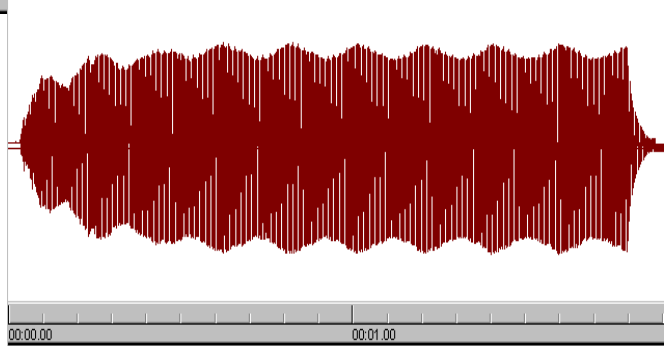
Ear drums will translate these changes in wave Forms as sound

- Sound is measured in → **dB (decibel)**
- Sound waves are known as **waveforms.**

Example of Waveforms

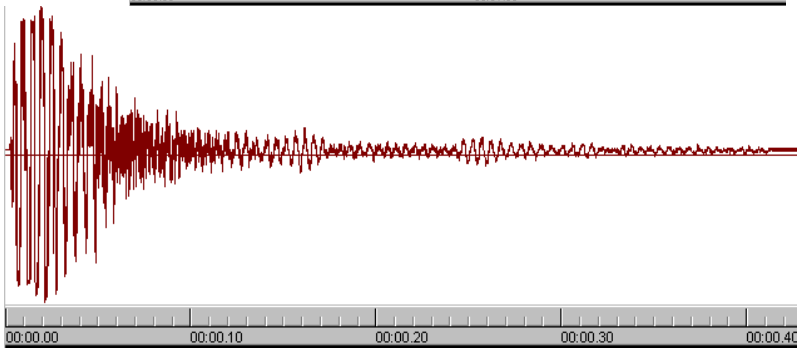


Piano



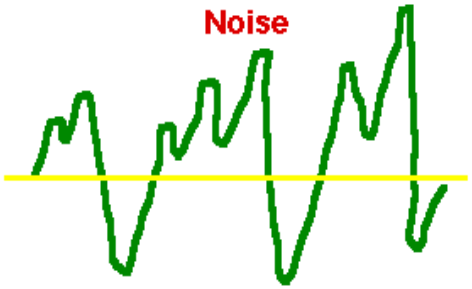
Pan flute

Snare drum



Sound

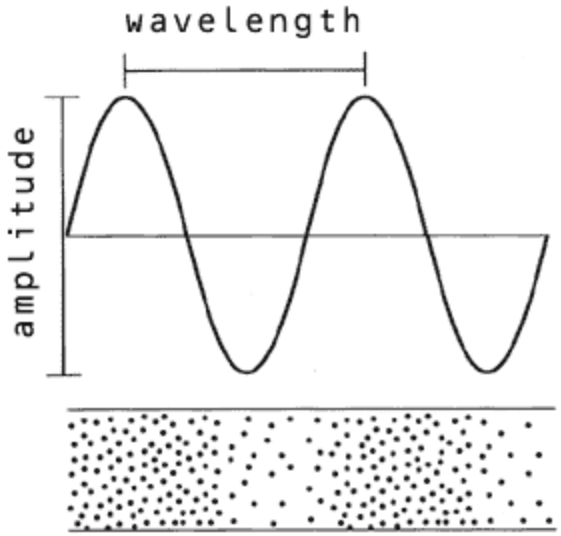
- A pleasant sound has a regular wave pattern. The pattern is repeated over and over.



- But the waves of noise are irregular. They do not have a repeated pattern.

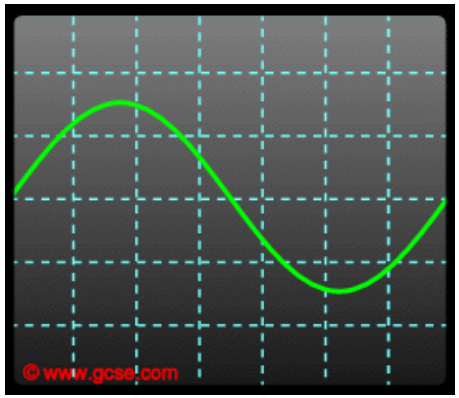
Characteristic of Sound Waves

- Sound is described in terms of two characteristics:
  - **Frequency** (or pitch)
  - **Amplitude** (or loudness)

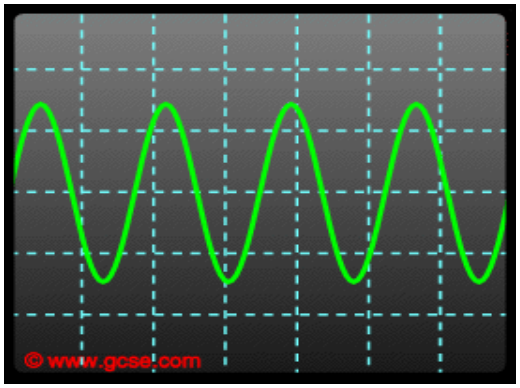


Frequency

- ***Frequency*** is a measure of how many vibrations 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.



Low pitch

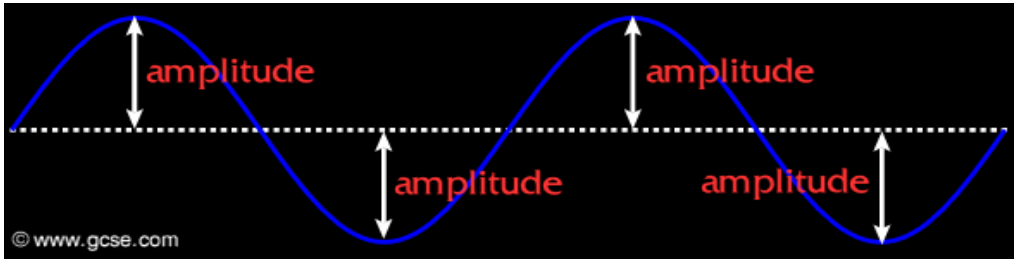


High pitch

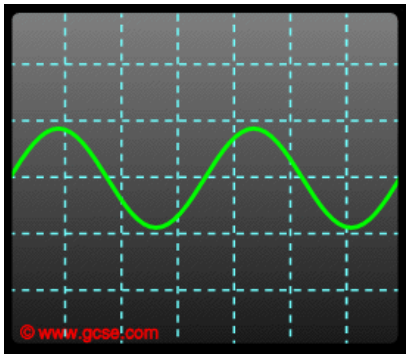
- Optimally, people can hear from **20 Hz to 20,000** Hz (20 kHz)
  - Sounds below 20 Hz are infrasonic
  - sounds above 20 kHz are ultrasonic.

Amplitude

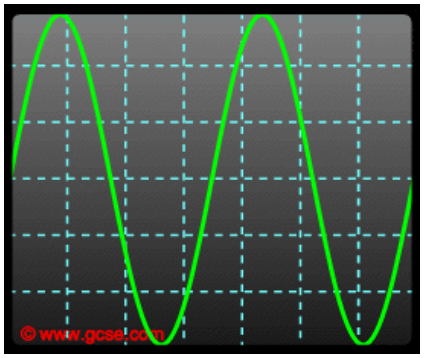
- ***Amplitude*** is the *maximum displacement* of a wave from an equilibrium position.
  - The louder a sound, the more energy it has. This means loud sounds have a large amplitude.



Quiet



Low amplitude

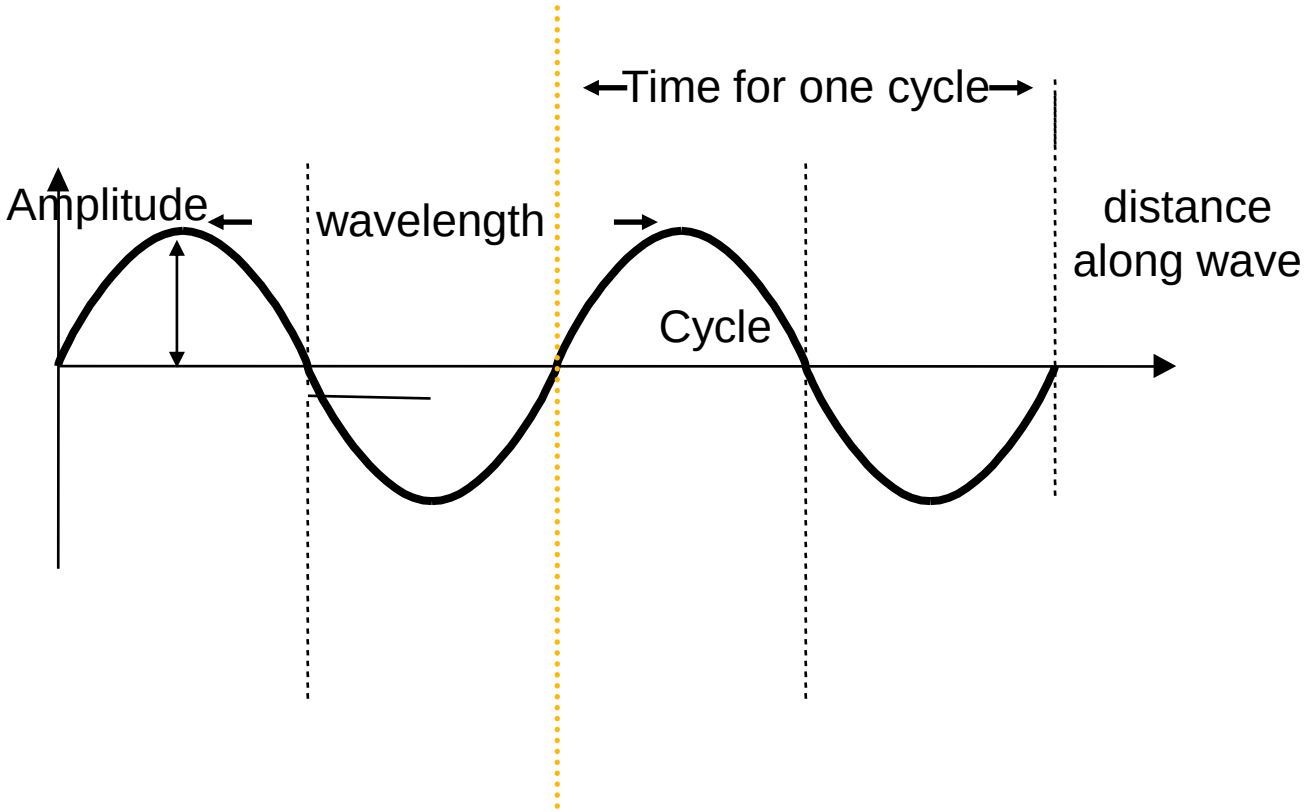


High Amplitude

Loud

- The amplitude relates to how loud a sound is.

Characteristic of Sound Waves



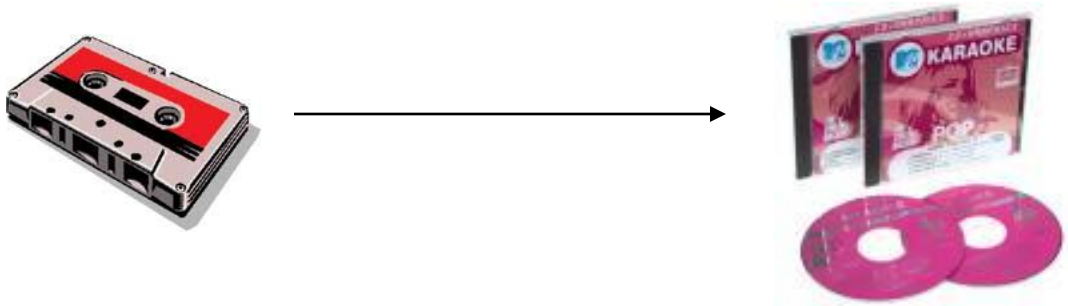
Analogue to Digital Audio

Analogue audio

- The name for an electronic signal that carries its information of sound as continuous fluctuating voltage value.
- non digital tape or audio tape recording of sound.

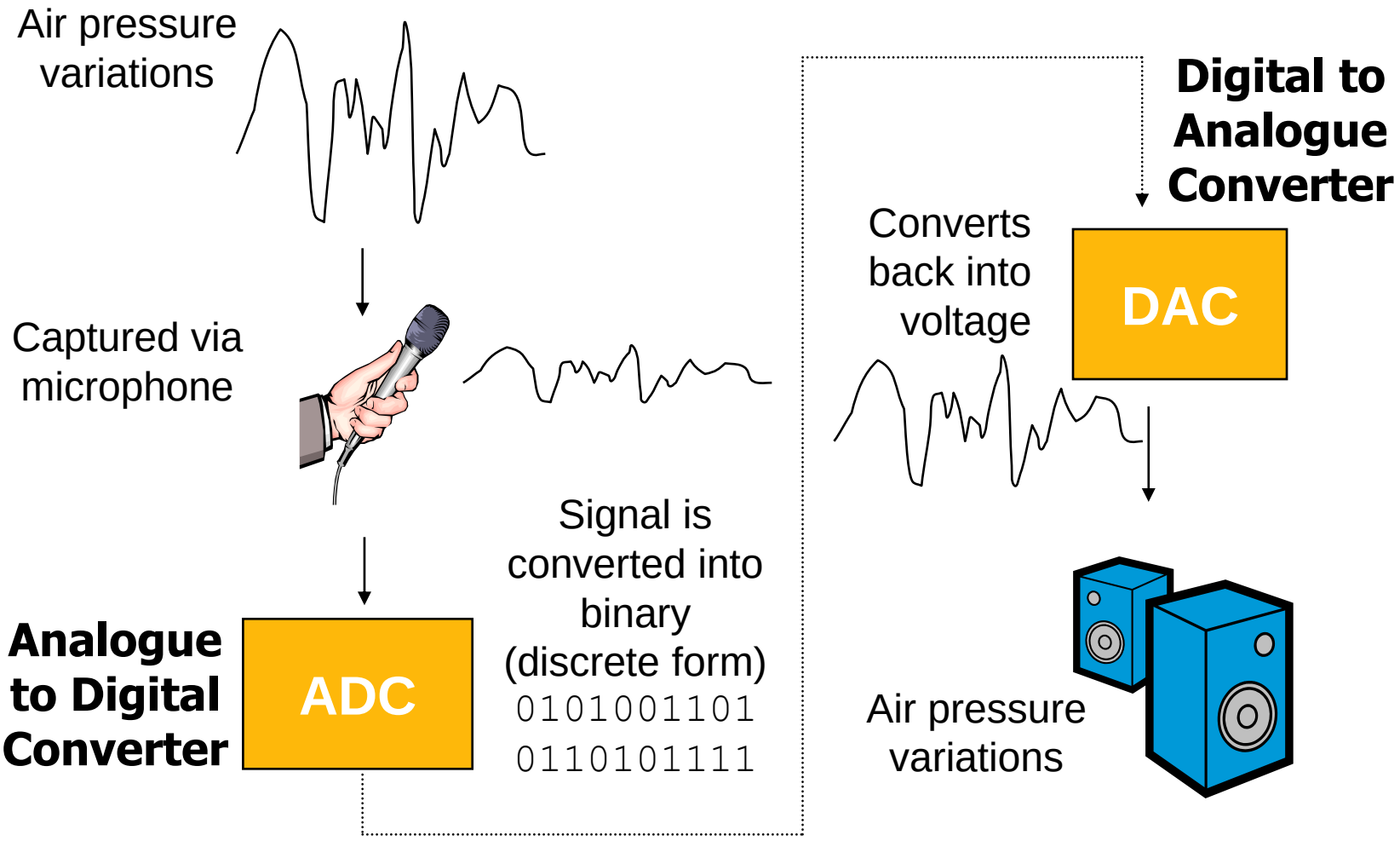
Digitizing

- the process of converting an analog signal to a digital one.



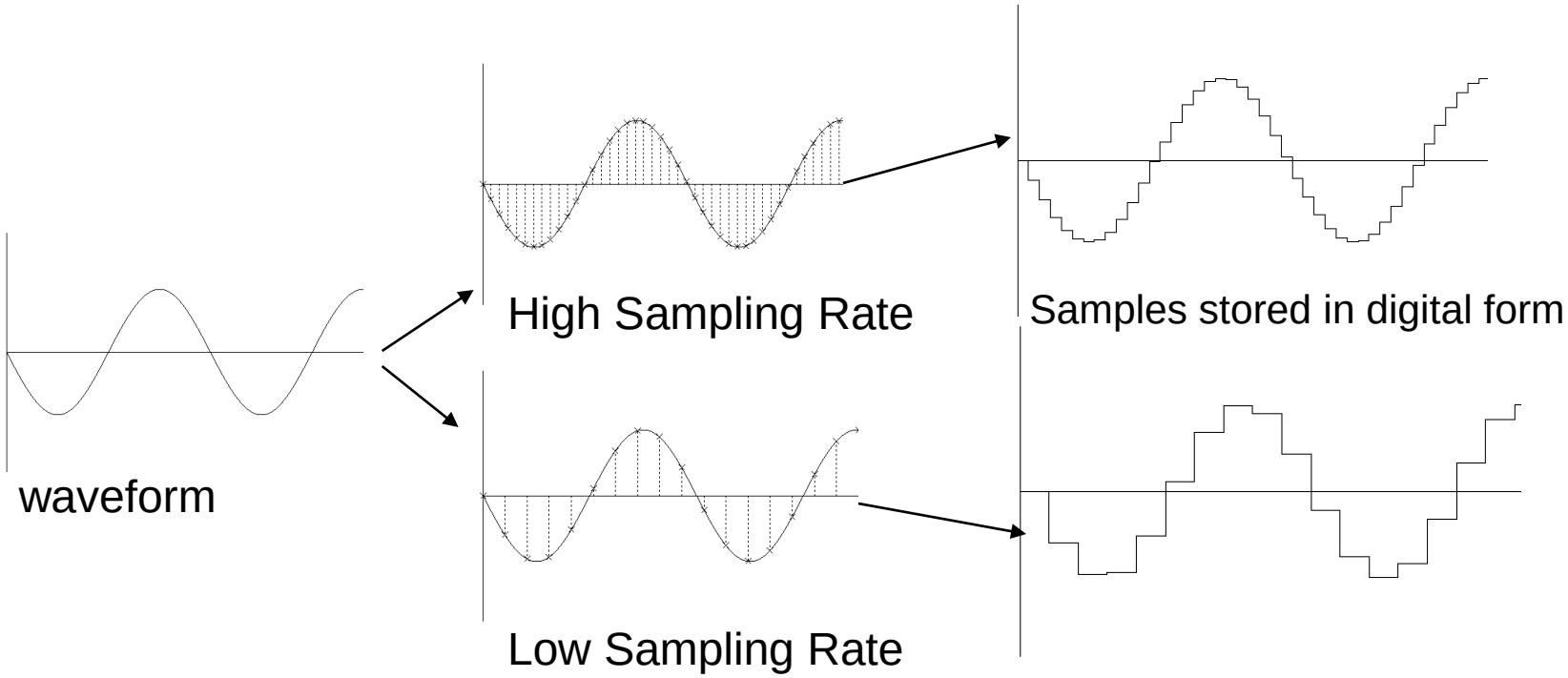
- A sound is recorded by making a **measurement of the amplitude** of the sound at regular intervals which are defined by the "sample rate".
- The act of taking the measurement is often called "sampling" and each measurement is called a "sample point".

Capture & Playback of Digital Audio

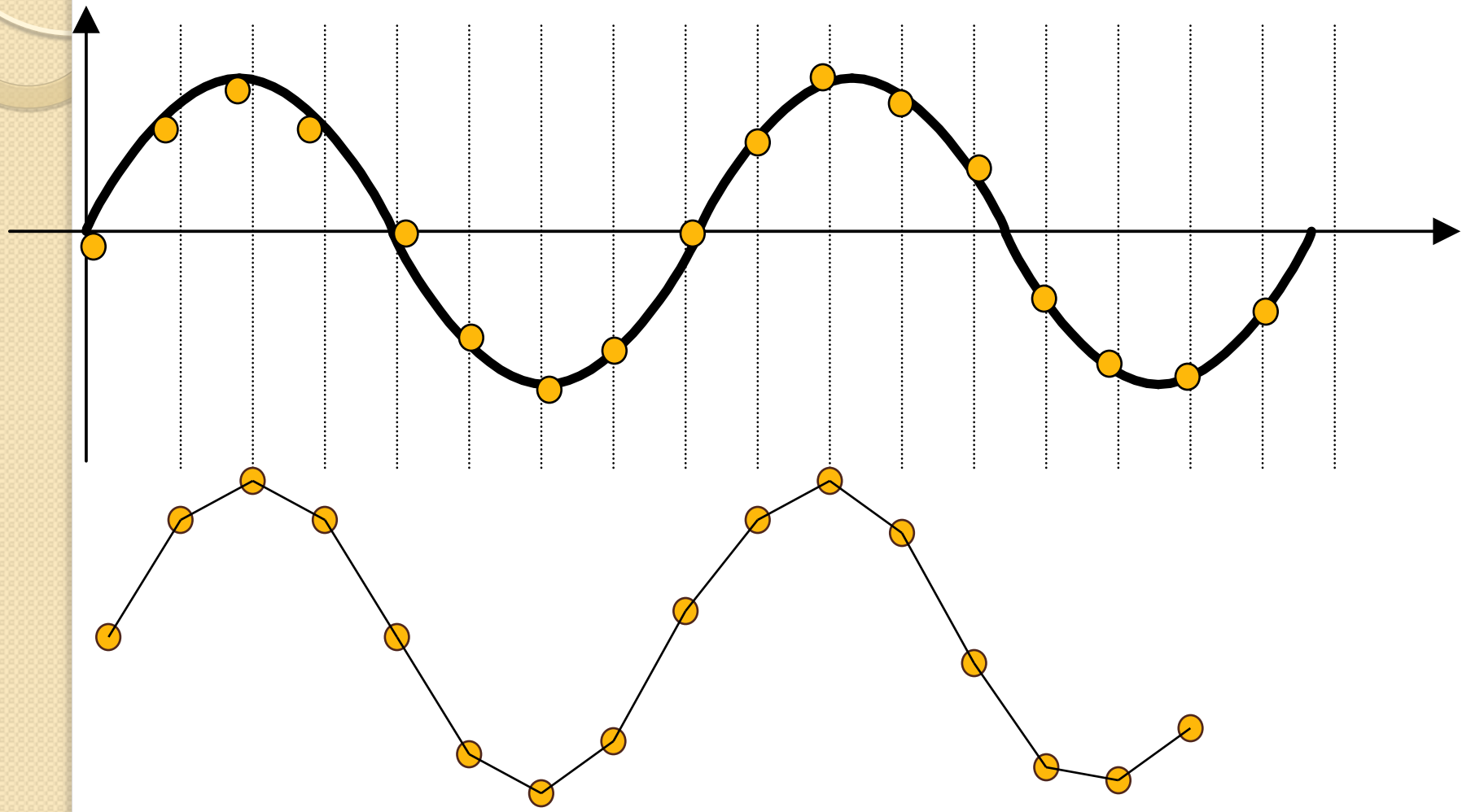


Digital Audio

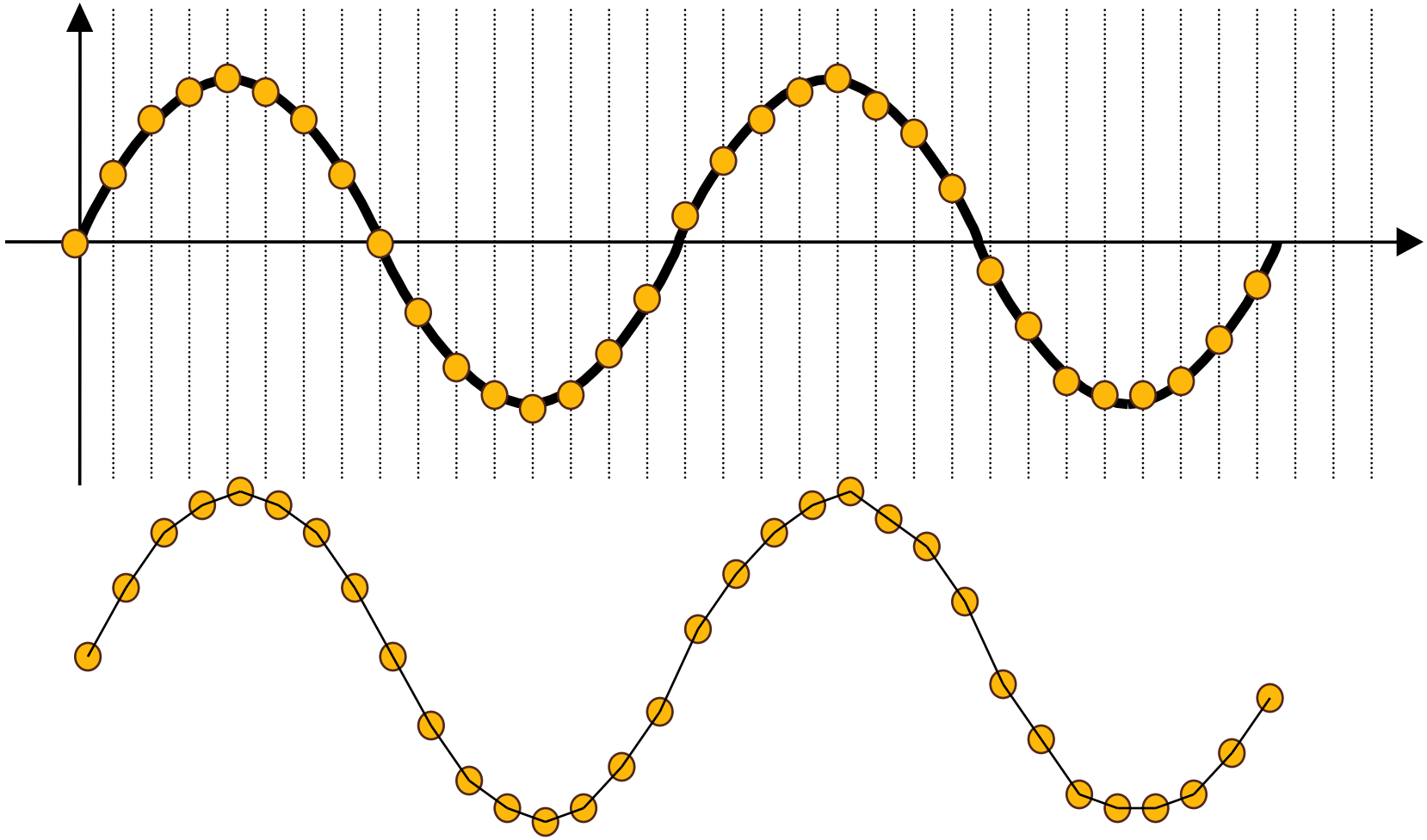
- Digital audio data is the representation of sound, stored in the **form of samples point**.
- Quality of digital recording depends on the ***sampling rate***, that is, the number of samples point taken per second (Hz).



Digital Sampling

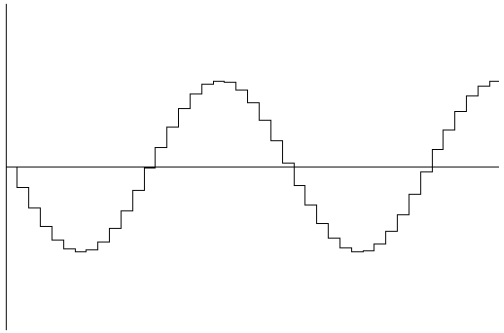


Digital Sampling

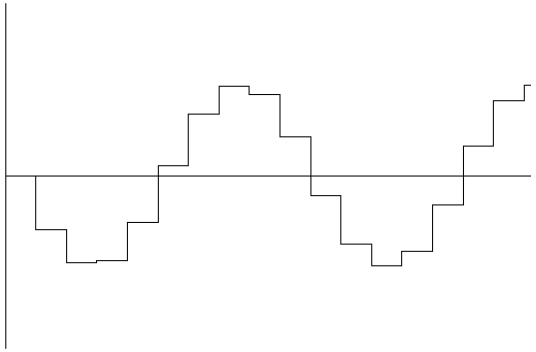


Digital Audio

- The 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).



High Sampling Rate



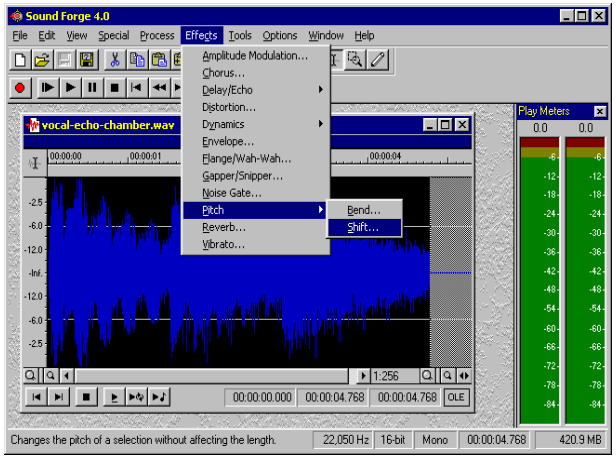
Low Sampling Rate

Digital Audio

- 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

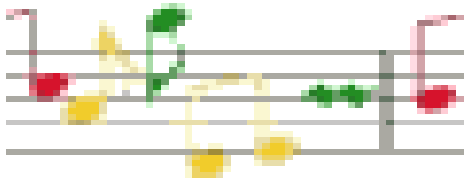
- More advanced Digital audio editing software:
  - One of the most powerful and professional PC-based packages is a tool called **Sound Forge**



- Others audio editing software:
  - COOL Edit Pro
  - Gold Wave
  - PROSONIQ SonicWORX
  - Samplitude Studio

Midi Audio

- **Musical Instrument Digital Interface**
  - 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 standardized and efficient means of conveying musical performance information as electronic data.
  - Is a easiest and quickest way to compose our own score.
    - (provided we have knowledge of musical instrument and composing)
  - It is in the form of music score and not samples or recording.



Midi Audio: Requirements

- To make MIDI score, we need:
  1. Midi keyboard / Midi keyboard software
  2. Sequencer software
  3. Sound synthesizer (built-in in to sound card)

7.3 Midi Keyboard

- MIDI keyboard is used to simplify the creation of music scores (MIDI information)
  - MIDI information is transmitted in "MIDI messages", which can be thought of as instructions which tell a music synthesizer how to play a piece of music.
  - The synthesizer receiving the MIDI data must generate the actual sounds.

Recording MIDI Files

Recording MIDI Files

- MIDI files can be generated:
  - by recording the MIDI data from a MIDI instrument (electronic keyboard) as it is played.
  - by using a MIDI sequencer software application.

Audio File Formats

- **MIDI**
  - ***.MID, *.KAR, *.MIDI, *.SMF**

- **AUDIO DIGITAL**
  - WINDOWS → ***.WAV**
  - MACINTOSH → ***.AIFF**
  - UNIX → ***.AU**
  - REALAUDIO → ***.RA**
  - MPEG3 → ***.MP3**

MIDI versus Digital Audio

- Advantages of MIDI over digital audio:
  - MIDI files smaller that digital audio files.
  - Because small file, MIDI files embedded in web pages load and play more quickly.
  - If MIDI sound source are high quality – sound better.
  - Can change the length of MIDI files without changing the pitch of the music or degrading the audio quality.

MIDI versus Digital Audio

- Disadvantages of MIDI over digital audio:
  - Because MIDI data does not represent the sound but musical instruments, playback will be accurate only if the MIDI playback (instrument) is identical to the device used in the production.
  - Higher cost and requires skill to edit.
  - Cannot emulate voice, other effects.

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.

Advantages & Disadvantages of Using Audio

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

Summary

- There are two main types of digital audio
  - **Sampled audio**
    - Captured by sampling an analogue waveform at a set rate
  - **MIDI data**
    - Instructions on how to perform some musical composition
- Sampled audio requires more storage space than MIDI information