Sounds

Introduction to Audiovisual Computing

Overview

- This lesson will explain the fundamental properties of sounds, how they are represented in a computer, and how you can combine them to make new sounds.
- By the end of this lesson you will be able to
  - Understand the structure of an uncompressed sound file.
  - Understand the basics of how simple sounds can be combined to make complex sounds

Sounds

- All sounds are pressure waves
- Pressure waves act on a medium
- We normally associate sound waves with pressure waves in the medium of air

Speed of Sound

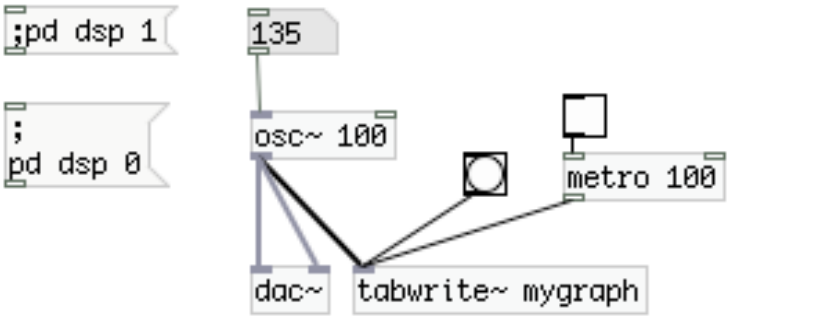
- Sound travels at 330 meters per second in the air

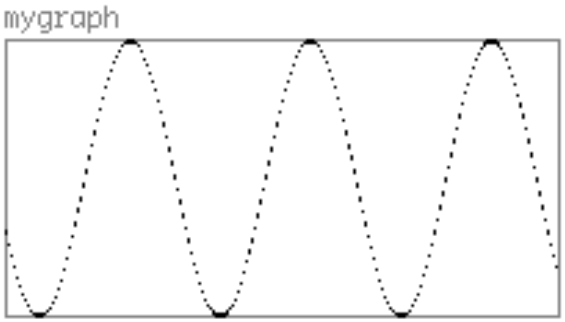
- Does sound travel faster or slower in water?

Speed of Sound

- Sound travels at 1,484 metres per second in water.
- Sound travels faster through liquids and non-porous solids.
- density *and* elasticity of the medium affects the speed of sound

Simple Harmonic Motion

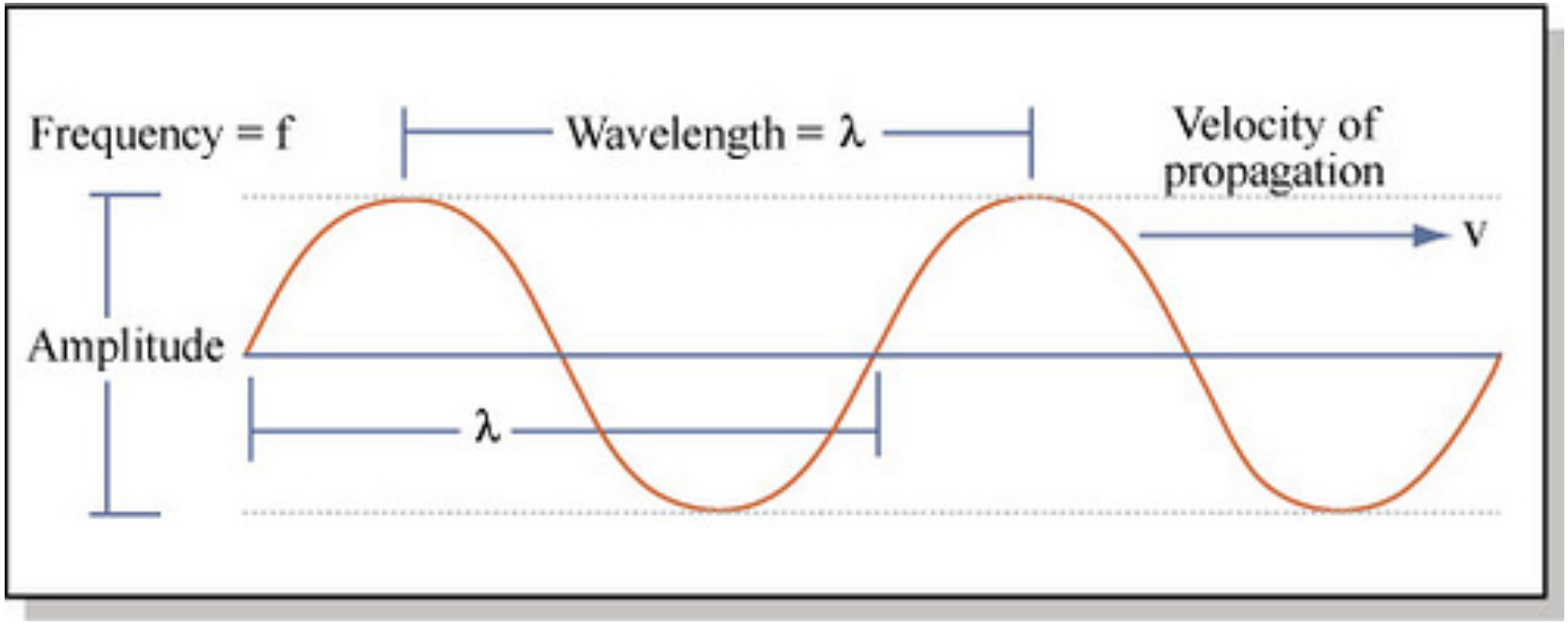




Simple Harmonic Motion

- Sound waves cause air molecules to squeeze together (Compression)
- This leaves a space (rarefaction) for more air molecules to rush into.
- The amount of movement is the loudness of the sound – the Amplitude,
- Amplitude is measured in dB (deciBels)
  - there will be more on dB later.

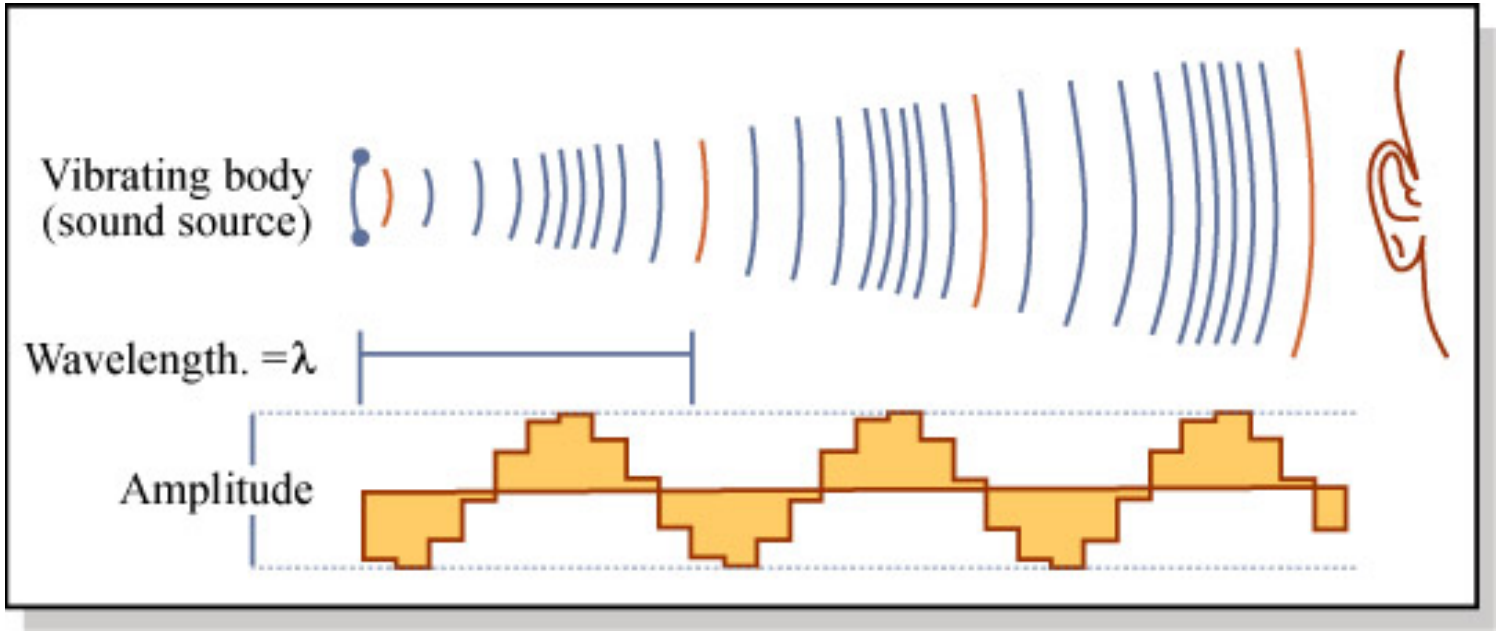
Representing Sound



Air & Voltage

- A microphone detects vibrations occurring in air and turns them into voltages.
- When these voltages are sent to a speaker, they make the speaker move backwards and forwards, which in turn makes the air move.
- If we use an amplifier to multiply the voltages before we send them to the speaker, the sound can get much louder.

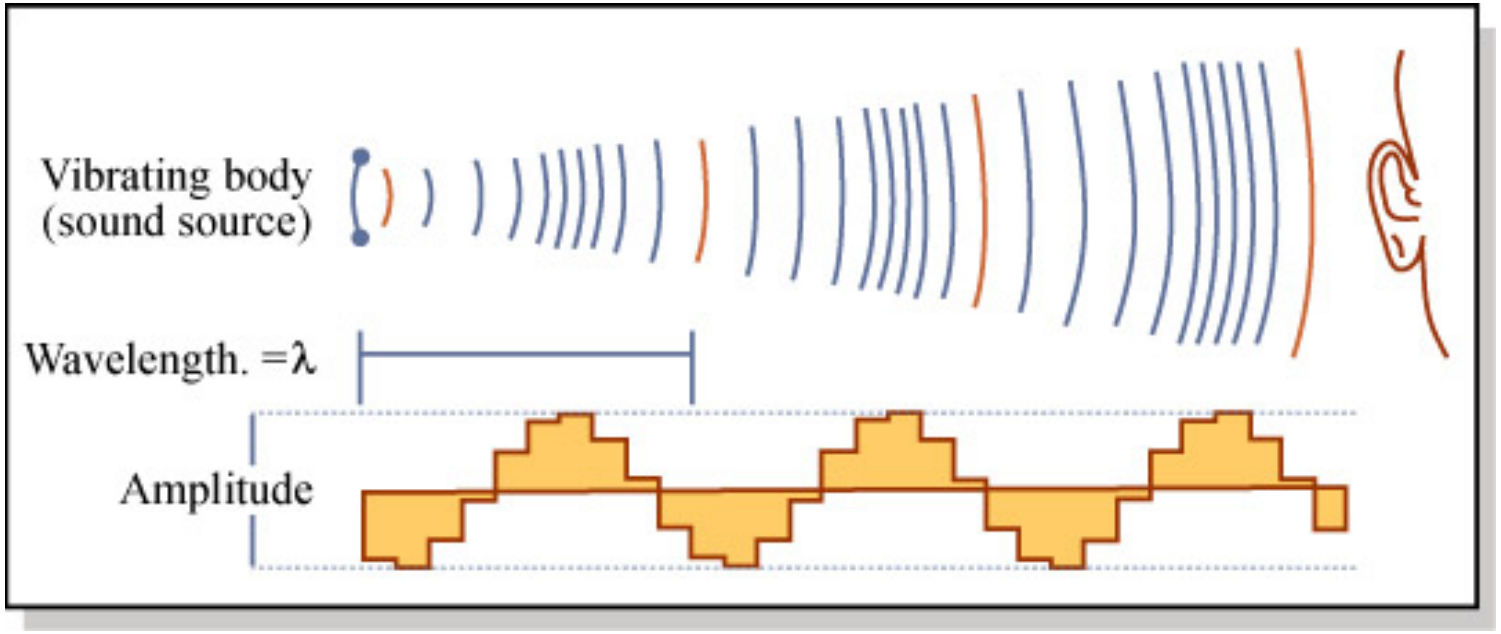
Representing Sound



Digital Audio

- The signal from a microphone is divided into slices, called ‘samples’.
- Each sample is a measurement of the amplitude (how much squeezing is going on) at that particular moment in time.
- These slices are stored sequentially in a file, or in a bit of RAM.

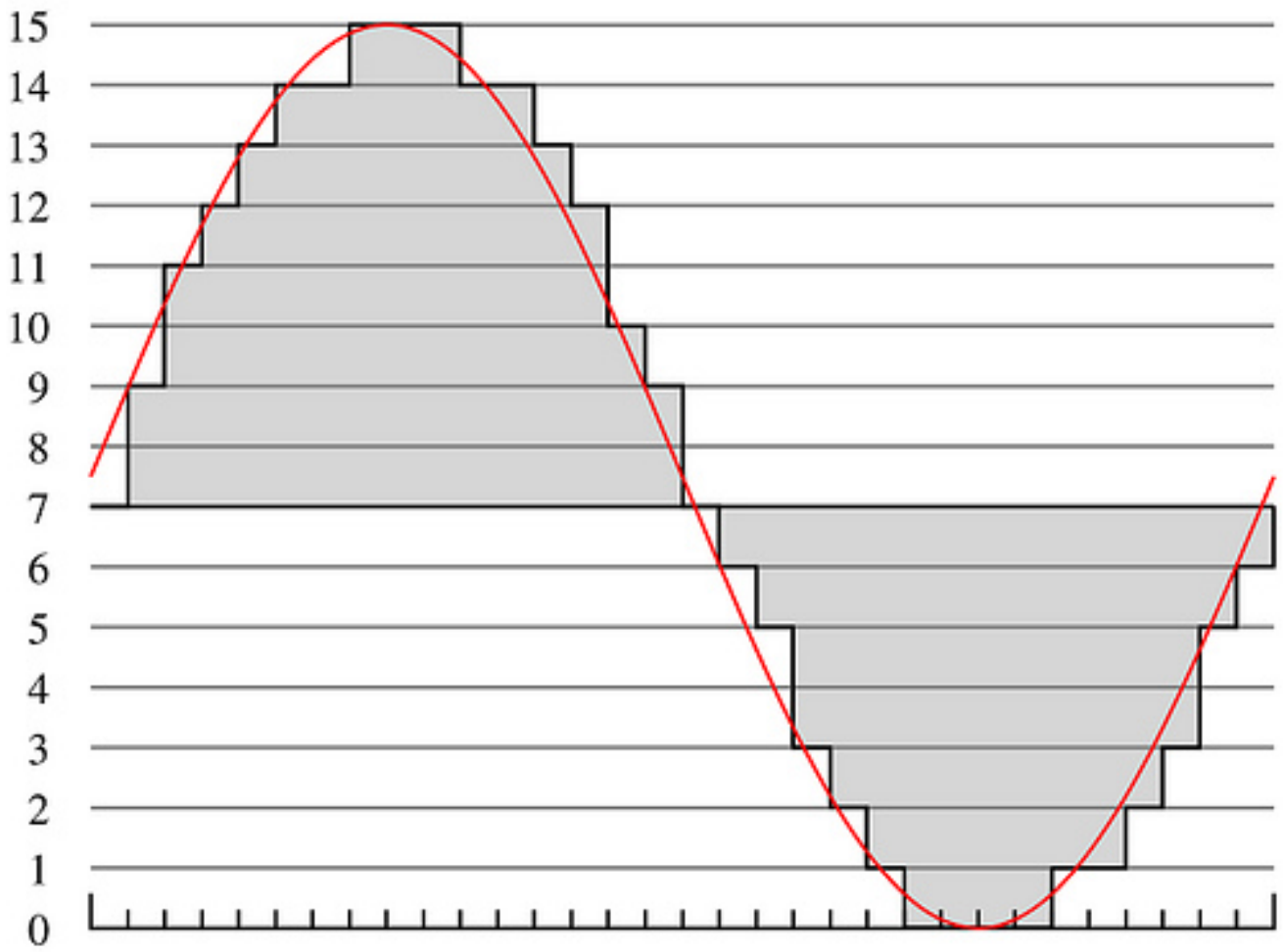
Representing Sound



Digital Audio

- Each slice is normally stored as a 16 bit number. Each bit stores a certain amplitude level.
- This allows for 65,536 different amplitude levels to be stored.
- Usually, there are 44,100 samples recorded every second.

Pulse Code Modulation



Real-time Digital Audio

- Digital Audio can be stored and playedback as files.
- We can easily use a small amount of ram to enable us to create and modify tiny sections of audio, and then string these together really quickly.
- If we do this fast enough, this allows us to create Digital Audio streams (buffers) that we can interact with in real time.

Simple and Complex sounds

- A sine wave is an example of a simple sound.
- Sine waves do not really exist in the acoustic world.
- However, all sounds can be said to be made up of combinations of sine waves.

Synthesising complex sounds

- We can create complex sounds by combining simple sounds
- We can multiply simple sounds individually to alter their amplitude
- We can add simple sounds together
- We can multiply signals together.
  - We can also control them with a MIDI instrument