



Programming Workshops

Principles of Computing

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Week 5

Falmouth University
Computing

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Today's Topics

- Audio representation
- Waves

Recap: Images

- When we looked at images, we considered them to have two dimensions - (x,y) and the image was static over time
- We could index a position (index), which contained R,G,B values (encoded as 0-255)
- (there are other colour representations)

Images over time

- Our image does not change over time
- It's static - so we don't need to care about time, only position.

Audio Waves

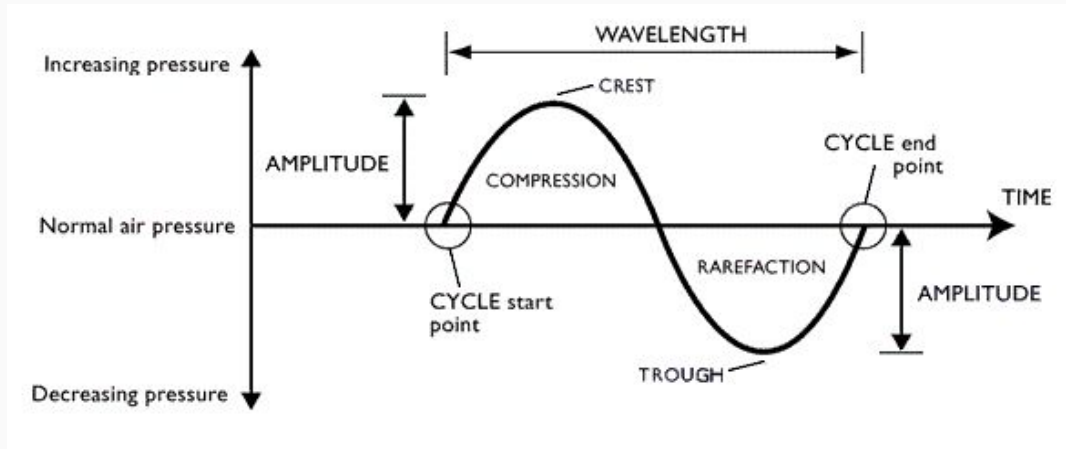
A (sound) wave of compression and refraction in an elastic medium, such as air, which can be detected by an animals sense of hearing.

In other words, we're showing change in pressure over time.

Not a biology lesson - so going to skip over how human audio sensors work.

Audio Wave

Example audio wave:



Two Key Concepts

Many animals are able to sense sound in two key ways: volume and pitch.

Volume The intensity of the change in pressure, as signified by the amplitude of a wave

Pitch The frequency of the change, as signified by the length of the wave and its velocity (i.e., “the speed of sound”).

Audio is analogue

- Audio is continuous change in pressure over time
- in other words, it's analogue
- Can anyone see a problem with this for trying to represent this on a computer?

Solution: sampling

- Rather than try to store the whole wave, why not store the wave at intervals then 'guess' in between them.
- Sampling
- We also need to decide the mapping of values to their 'loudness' - how many do we store?

One method is to represent the wave itself and one approach to do this is Linear Pulse Code Modulation (LPCM):

- An array of integers is created.
- The value of these integers represents the amplitude of the wave:
 - With linear coding, the way how bytes correspond to real-world measures –called quantisation– is uniform across the range.
 - The positions in the array represent time, and so each element contains a sample of the wave amplitude.

- Sample Rate** Number of times (per second) we change/record the value
- Bit Depth** How many different 'levels' of loudness do we store?

- Frequency - how 'fast' the wave repeats
- We break the frequency into 'notes'
- chromatic scale
 - Break this into repeating blocks of 12
 - Ratio between notes is important (see lab script)

Audio Toy!