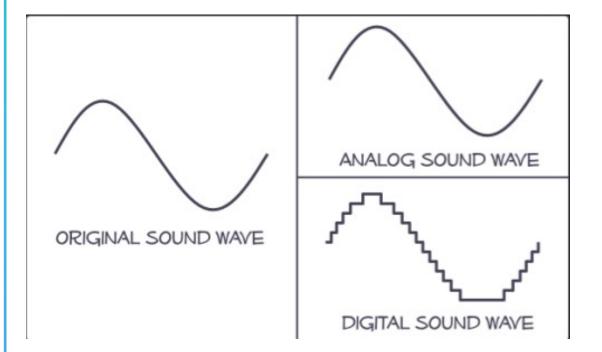
MACHINE AUDIO

Kyle McFadden | Braeden Neta | Hunter Janssen



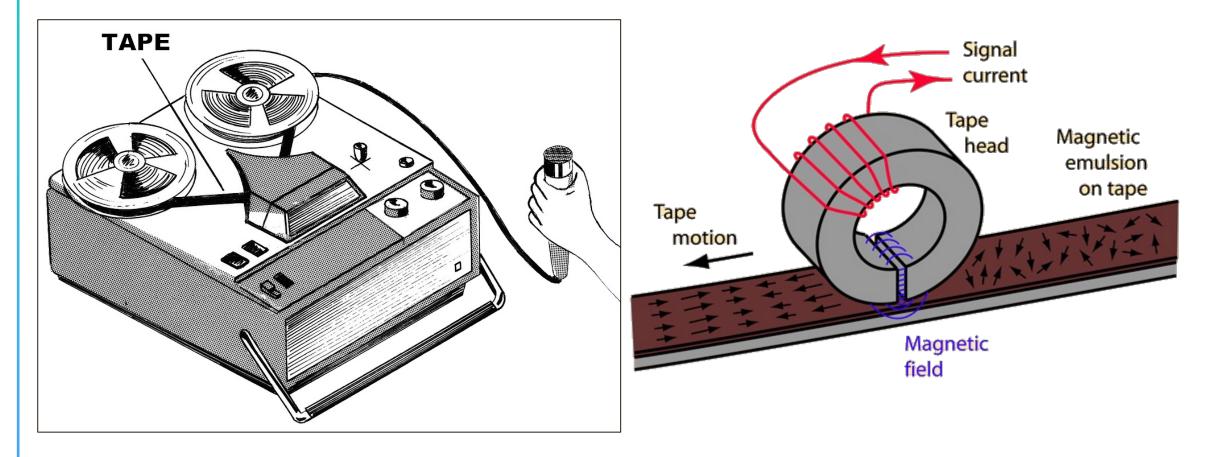
 \mathbf{O}

Analog Vs. Digital

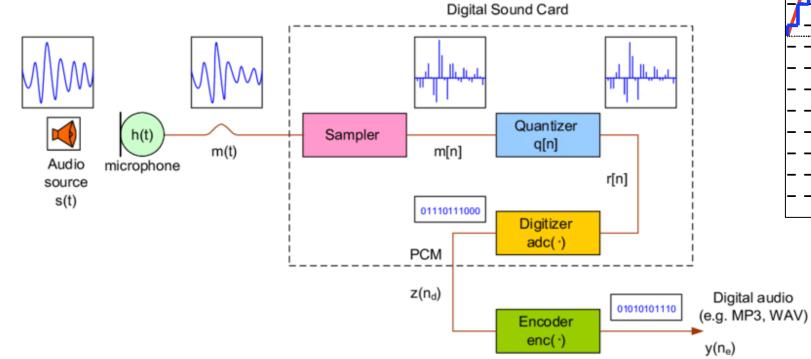


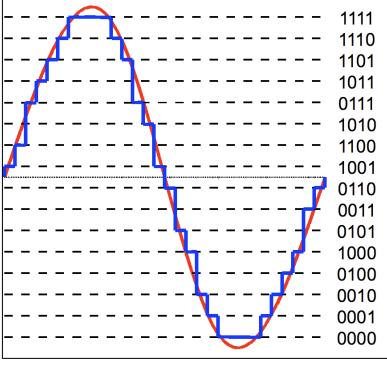
- Analog waveforms have an <u>infinite</u> number of values between two points
- Digital waveforms have a <u>finite</u> number of values, often grouping similar values to whichever best matches those values

How Audio is Recorded to Analog









Top:

An example of what a PCM sound graph looks like using a 4-bit depth resolution

Source: "Digital Recording System Identification Based on Blind Deconvolution" – Kulhandjian et al.

Audio Compression

Lossy Compression (MP3, AAC, Ogg Vorbis)

- Pros:
 - Light on storage space
 - Various levels of compression
 - Removes insignificant parts of the audio
- Cons:
 - Data is permanently lost when compressed

Lossless Compression (FLAC, ALAC)

- Pros:
 - Can be uncompressed back into its original form
 - No enhancements are needed to restore the sound

• Cons:

• Can only compress the file to a certain extent; therefore, the file is still somewhat large



First Computer Music

- Manchester Mark 1
- Created at Manchester University
- Integrated "Hoot" command
- Melodies from simple tones



Release of the MIDI

- Musical Instrument Digital Interface
- Enabled computers, synths and musical hardware to communicate
- Easily adjust tone, pitch, and noise levels



Music Editing ^{*} Software



- Cubase software initially released April 1989
- Released as a MIDI for the Atari ST
- First digital music editing software
- Still receiving present day updates on Windows and Mac



Audio Example

16-bit audio



8-bit audio



Please give a file. Case Sensitive!! MIT.wav

RIFF Chunk ID File size Format

:RIFF :18170128 bytes :WAVE

fmt Chunk :fmt ID Chunk size :16 bytes Audio Format :1 Channels :2 Block Align :4 Bits per Sample :16 Byte Rate :192000 Sample Rate :48000 kHz

data Chunk ID :data Chunk size :18169884 bytes Section of Data :==== Number of Samples :9084942

Variable sizes Char size :1 byte Int size :4 bytes Press any key to continue . . . |

Code Overview

- The code would take a given wave file, assuming it was at least 16-bit or higher quality, and modify the bits in the file making it so that the resulting wave file would be 8-bits.
- A separate c++ project, displayed here, takes in a wave file and displays its contents.

What We Learned

- The Format of a Wave File.
- The discovery of bit operators and additional variable type conversions in c++.
- Music Functions

```
Please give a file. Case Sensitive!!
MIT.wav
What would you like to do?
1 to play music | 2 to convert to 8-bit | 3 to exit program
1
Sound playing!
```

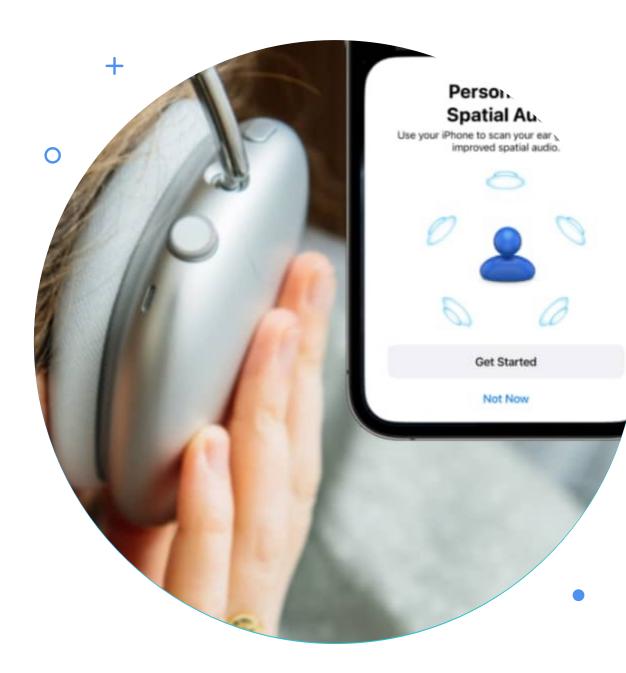
Complications

- Reading in specific sub chunks of a wave file.
- Saving the data array that contained the music.
- Modifying the bits in the data array.
- Writing the new data to a new wave file.

00000000 10000100 00000000 00111101 00000000 10101011 00 11111101 11111111 10001100 00000000 11101010 110101 00000000 10010010 1111111 01111000 00000 10001001 11111111 10000101 0000000 00000000 01110001 11111111 01110000 111111111 01100101 00000000 01101000 00000000 01101110 00000000 01110110 11111111 01011001 10000010 11111111 01011001 00000000 10000110 001111 00000000 11010010 11111111 10010111 111111111 10101100 10110001 0000000 00100101 0000000 1111 00000000 01000100 00000000 10110001 01111011 00000000 11011001 00000000 10011000 01000001 00000010 01111



+



Spatial Audio

- Creation of 3-Dimensional Audio
- Most namely available through Apple Headphones
- Improve immersive feel of VR, gaming, and sound passthrough

Al in Music Production

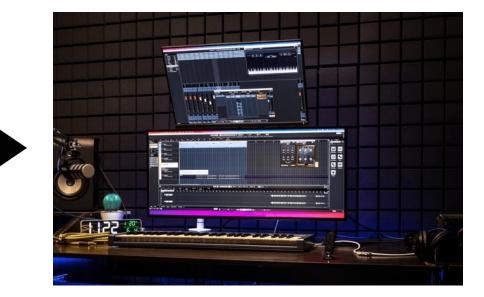
- Quickly generate original pieces
- Users specify specify mood, style and duration
- Algorithms that optimize and balance
- Predict musical trends
- Used in film, games, and advertising



Digital Outdoes Analog

- Professional quality without expensive physical equipment
- Emulate any type of instrument
- Create, mix, and master music in one place







QUESTIONS?

+

Sources

History:

- https://www.musicradar.com/news/tech/a-brief-history-of-computer-music-177299 https://history-computer.com/commodore-64-guide/ https://www.musicradar.com/news/tech/30-years-of-midi-a-brief-history-568009

Future:

https://www.bbc.com/news/magazine-37507707

Making Audio:

- https://audiouniversityonline.com/analog-vs-digital-audio/
- https://en.wikipedia.org/wiki/Pulse-code modulation •
- https://www.researchgate.net/publication/331979558 Digital Recording System Identification Based on Blind • Deconvolution#pf2
- https://www.izotope.com/en/learn/digital-audio-basics-sample-rate-and-bit-depth.html
- https://riverside.fm/blog/lossless-audio-formats

Condensing Audio

- https://ccrma.stanford.edu/courses/422-winter-2014/projects/WaveFormat/ ٠
- https://stackoverflow.com/questions/13660777/c-reading-the-data-part-of-a-wav-file