Music Generation and Sound Processing in a Functional Programming Paradigm

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Digital Synthesis

- First pioneered in 1957 with a punch card controlled analog synthesizer using 750 vacuum tubes.
- Popularized in the music of the 1980's by the Yamaha DX7
- Extensively popular today across many disciplines.
    - Music
   - Telecommunications
    - Speech Translation

Additive Synthesis

- Summation of input wave signals to create a new output signal.
- Synthesizing a Fourier series by weighted summation of harmonics of the basic sine wave can generate all waves imaginable.
- Limited only by processing power.
- Resulting waveforms can be stored into waveform tables.

Wavetable Lookup Synthesis

- Waveform values stored into a lookup table.
  - Typically a single period is stored.
  - Can store complex waveforms.
- Ease of access based on frequency.
- Faster and more efficient synthesis method.
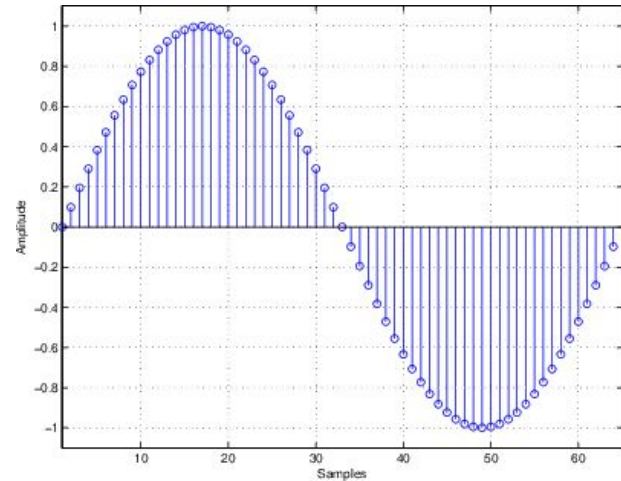
ADSR Envelope

- Applies dampening/expansion to different stages of a sound.
  - Attack - Modifies sound from 0 to max amplitude from noteOn.
  - Decay - Modifies sound from max amplitude to Sustain level after Attack phase.
  - Sustain - Level of max amplitude to hold constant after Decay phase.
  - Release - Modifies sound from Sustain level to 0 after noteOff.
- Drastically alters a sound's character.
- Can be extended to a DAHDSR Envelope.
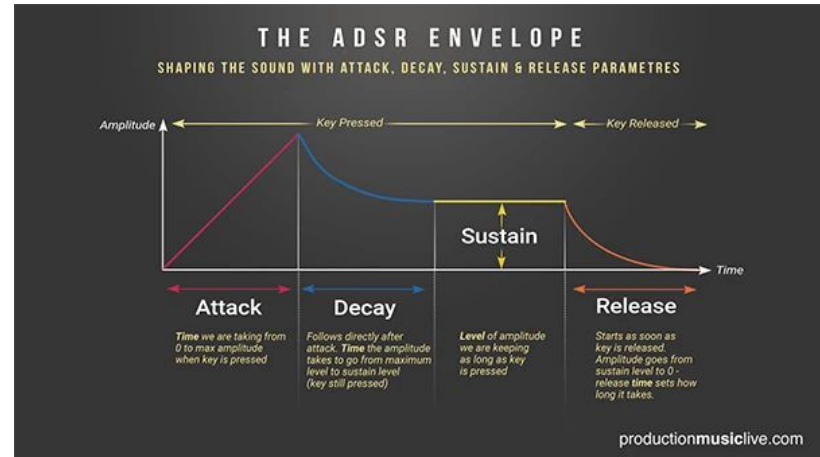
MIDI

- Stands for "Musical Instrument Digital Interface"
  - *"Technical standard that describes a communications protocol, digital interface, and electrical connectors that connect a wide variety of electronic musical instruments, computers, and related audio devices for playing, editing and recording music."*
- Contains detailed instructions that can be interpreted into musical notation.
- Can further contain other detailed information for synthesizer standards such as General MIDI (GM)

Waveform Audio File Format

- An audio file format standard, developed by Microsoft and IBM, for storing an audio bitstream on PCs.
    - Resource Interchange File Format (RIFF) bitstream format
    - Pulse Code Modulation (PCM) Encoding
    - Uncompressed, universally supported.

WAV

Applications

- Music and Sound Generation
- Text to Speech
- Digital Signal Processing
- Telecommunications
- Many more...

Thank you for your attention!