MIDI and Digital Audio

CSC 220 - Object-Oriented Multimedia Programming

Musical Instrument Digital Interface (MIDI)

- MIDI stores, transmits, and receives information to control electronic musical instruments, including hardware and software synthesizers
- MIDI messages are packets of data, sent or received by a synthesizer or MIDI controller device.
- MIDI is not Digital Audio
- Digital Audio is a sequence of binary numbers representing measurements of sound pressure levels (SPLs)
- MIDI numbers do not represent sound; they represent control of instruments.

MIDI Short Messages

- See ‘javax.sound.midi.ShortMessage
- See the MIDI specification: http://midi.teragonaudio.com/
- See `NOTE_ON` to start a note, `NOTE_OFF` to stop it, `PROGRAM_CHANGE` to change the instrument voice, `CONTROL_CHANGE` for audio effects.
- There are many distinct messages: http://midi.teragonaudio.com/tech/midispec.htm

Chords and Instrument Voices

- Polyphonic synthesizers can play many notes at a time. Monophonic synthesizers play one note at a time.
- A MIDI channel 0..15 represents one instrument, thus a given synthesizer supports addressing up to 16 simultaneous instruments, each of which may be polyphonic.

Program Change and Control Change

- A Program Change messages enables a channel to play a new instrument 0..127
- Bank switching may support greater than 128 instruments
- A Control Change applies an effect to a channel in the amount 0..127 or 0..16383
- Not all synthesizers support all combinations of `NOTE_ON` ranges, programs, and controllers.

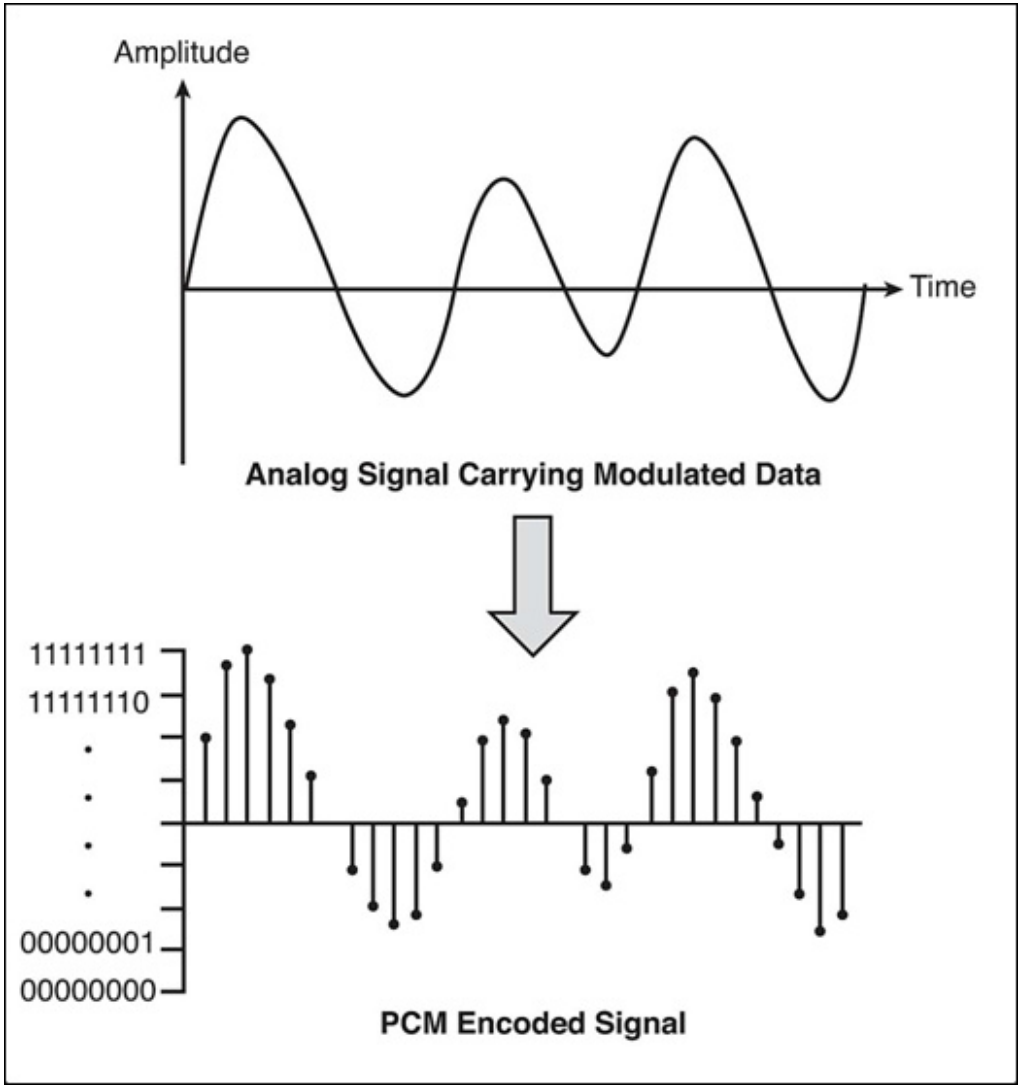
Hardware and Software Synthesizers

- A synthesizer may be a hardware device connected via a MIDI cable, or software connected to a controller via a soft bus.
- There are three basic approaches to synthesizing sound:
  - Harmonic synthesis combines overtones by adding or subtracting component sine waves. It models sound.
  - Sampling uses recorded instruments sounds and pitch shifting as the basis for sound reproduction
  - Physical modeling uses software that models the acoustic properties of physical instruments

Pulse Code Modulation (PCM)

- PCM is a digital representation of Sound Pressure Level (SPL). It is the primary digital representation of audio signals (sound).
- It is not instrument control data like MIDI.
- PCM converts a series of measurements of analog SPLs to a sequence of binary numbers, where the magnitude of a number represents the SPL strength during a brief interval of time.

Pulse Code Modulation (PCM)



- Source: http://www.electronicshub.org/modulation-and-different-types-of-modulation/

PCM Resolution

- Samples per second gives the rate at which PCM takes measurements of sounds. The lowest standard rate is 44,100 samples per second.
- Bits per samples gives the resolution of each sample in terms of how many bits to store each measurement. 16 bits per sample is a common minimal amount.