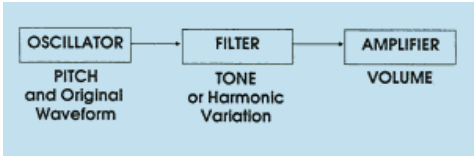
Sound Synthesizers

Synthesizer Categories

- ***Analog***
  - Developed in the late 60s - still valued today
  - Tubes and transistors create sounds.
- ***Digital***
  - Developed in the 70s - matured in 80s
  - Chips and samples create and recreate sounds.
  - Still improving today
- ***Software***
  - Plug-ins do anything a digital synthesizer can do.

Basic Analog Synthesis



Oscillators Produce:

- Sine waves
  - Pure - no overtones of their own
- Square waves
  - Produce harmonics - f x 3, f x 5, etc.
  - Mellow sound, like a clarinet

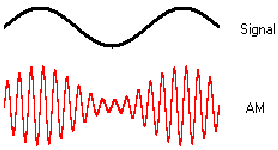
Oscillators Produce:

- Triangle waves
- Sawtooth waves
  - Rich in harmonics - f x 2, f x 3, f x 4, etc
  - Good for brassy sounds

- Pulse waves
  - Produces varying harmonics depending on relative length of pulses and time between.
  - Harmonics can be controlled

Modifying the Waveforms

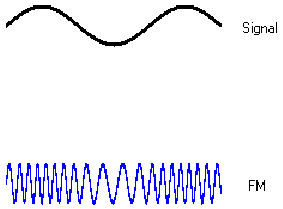
- Amplitude Modulation (AM)
  - Use another signal to control the volume over time
  - Create the envelope
    - Attack, Decay
    - Sustain, Release
  - Create tremolo



- Example signal supplied by a Low Frequency Oscillator (LFO)

Modifying the Waveforms

- Frequency Modulation
  - Use another signal to control the frequency over time
    - Make it waver
    - Make it pulse
    - Create vibrato
    - Make it slide up into pitch



Modifying the Waveforms

- Voltage Controlled Filters (VCF)
  - Use another signal to control a high or low-pass filter over time.
  - Example: sound gets more bass-y as it decays.

Modifying the Waveforms

- Pulse Width Modulation (PWM)
  - Use another signal to control the time between pulses, and width of pulses
  - Example: harmonics change in number/ intensity during the envelope time

Additive Synthesis

- Uses separate oscillators to add harmonics where we want them.
- Each harmonic can have its own envelope, etc.
- Also noise* can be added for percussive details, like the B in “Boom”
  - *Usually randomized high frequency signals

Sample Synthesis

- Most common in today’s music production
- Uses carefully recorded samples of an actual instrument. Any instrument you want.
- Several different versions of notes available depending on how hard the musician strikes the key. Realistic dynamics.
- Also filter and envelope controls.

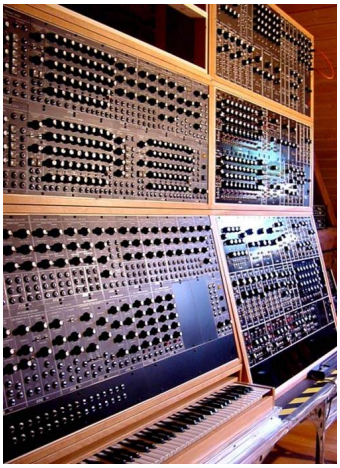
Subtractive Synthesis

- Subtracting harmonic content from sound with an audio filter.
- For example: take output from sawtooth generator and use a low-pass filter to dampen (reduce) the higher partials/ harmonics
  - Produces a sound like a bowed string.

Moog

Adding Modular Options

Getting Carried Away?



Modern

Simple Software Synthesizer