

Lecture 14: Additive & AM Synthesis

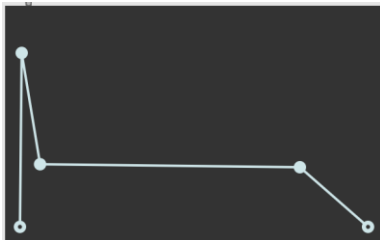
Instructor: Hao-Wen Dong

Example 1: ADSR envelopes ("1_adsr_envelope.maxpat")

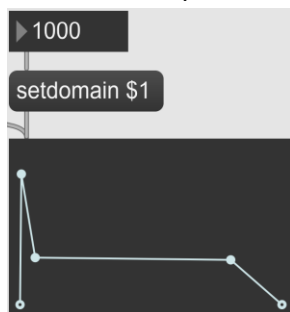
- The ADSR envelope is a commonly used envelope for modulating the amplitude of an audio signal.



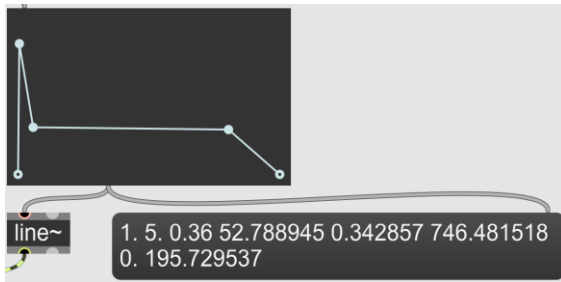
- Attack:** the **time** taken for the level to rise to the peak
 - Decay:** the **time** taken for the level to reduce to the sustain level
 - Sustain:** the **level** maintained until the key is released
 - Release:** the **time** taken for the level to decay to zero
- Use the "function" object to create an interactable ADSR envelope



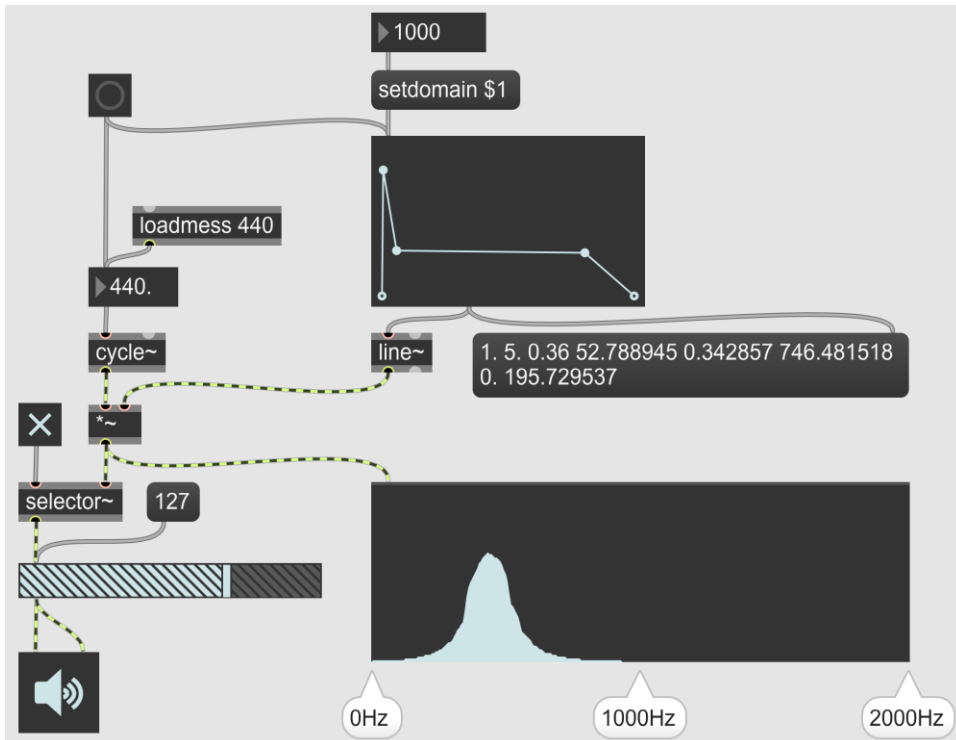
- Use a message "setdomain X" to set the range of the y-axis of the "function" object, which corresponds to the duration of the whole ADSR envelope



- Use a “line~” object connected to the second outlet of the “function” object, which outputs a series of numbers that describes the function



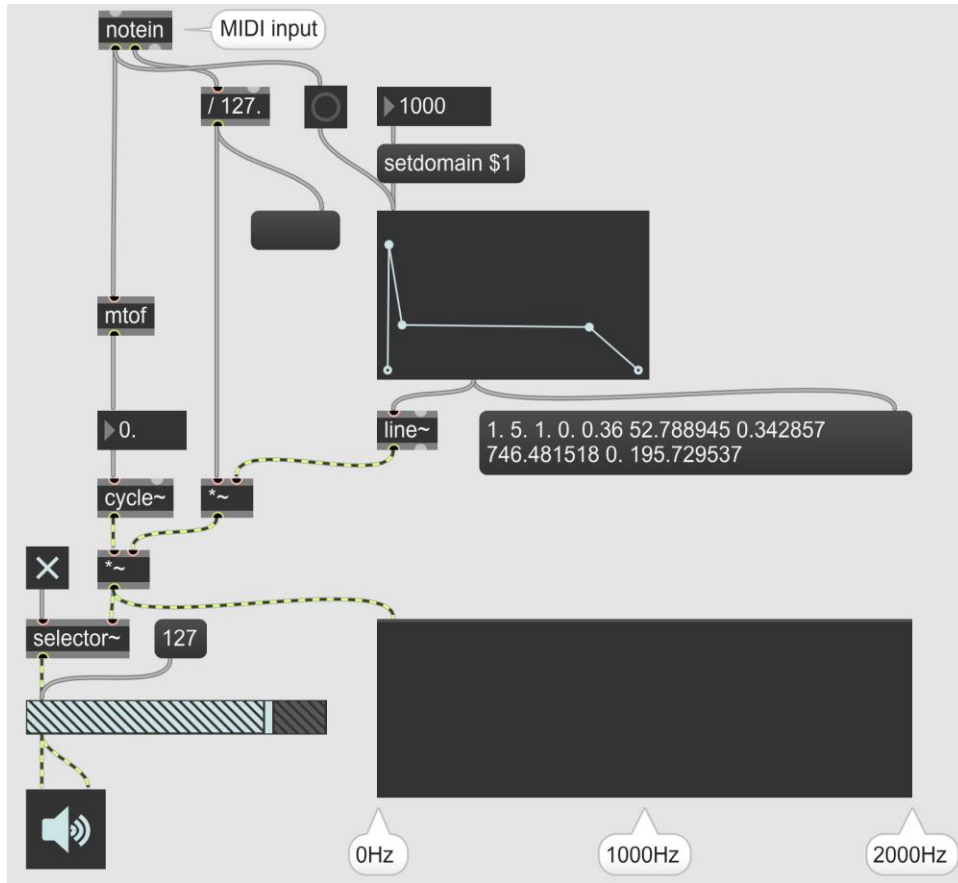
- Use the ADSR envelope to modulate the amplitude of a sinusoid signal



- Note that a bang message is required to trigger the “function” object to send a message to “line~”

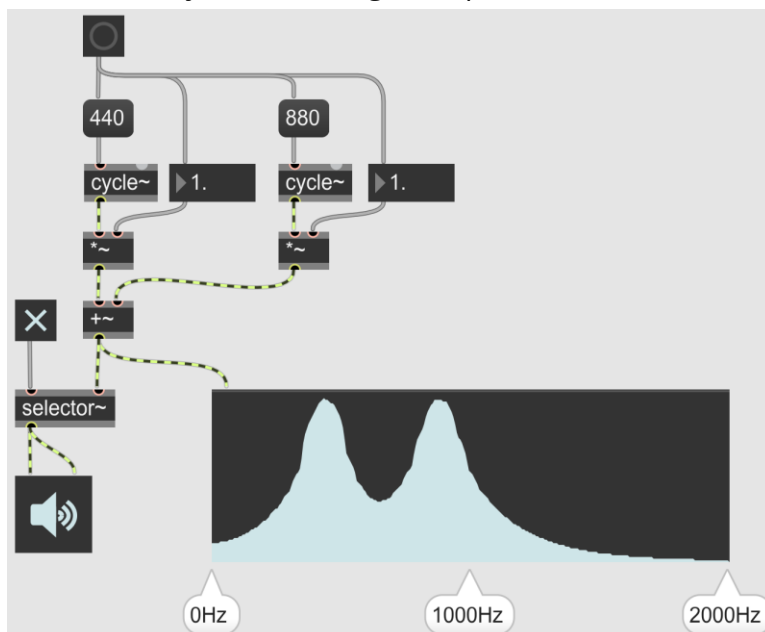
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- Use the “notein” object to take MIDI inputs if you have a MIDI input device

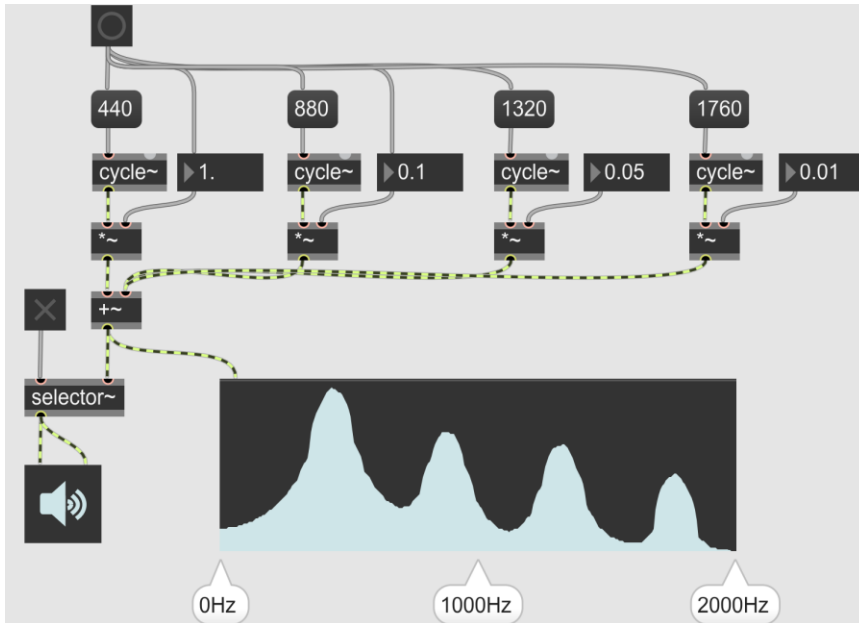


Example 2: Additive Synthesis (“2_additive_synth.maxpat”)

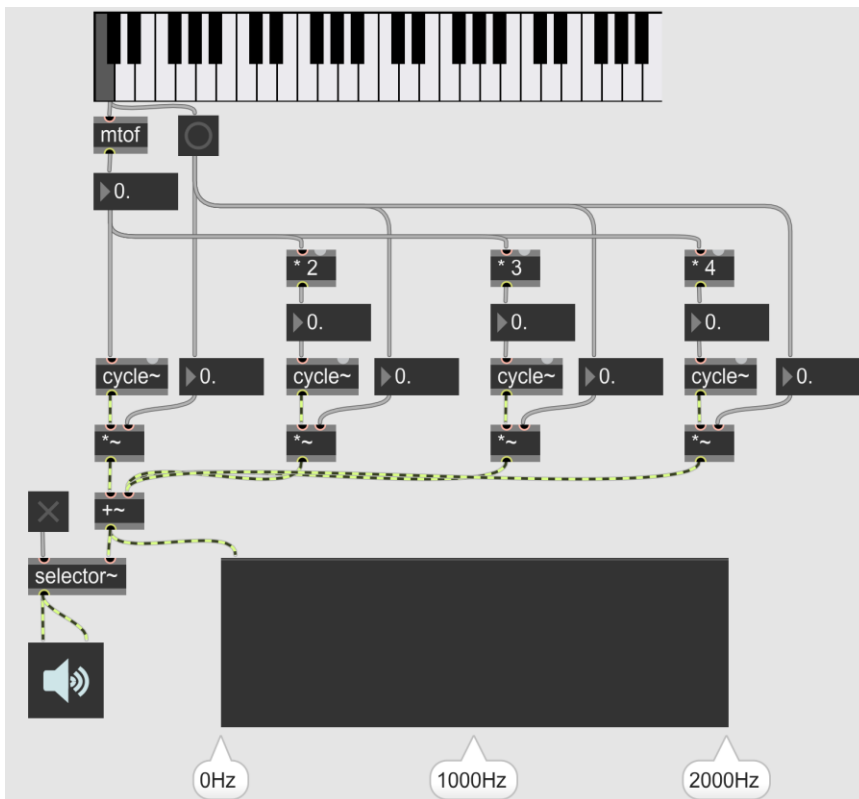
- Use a “+~” object to sum signals up



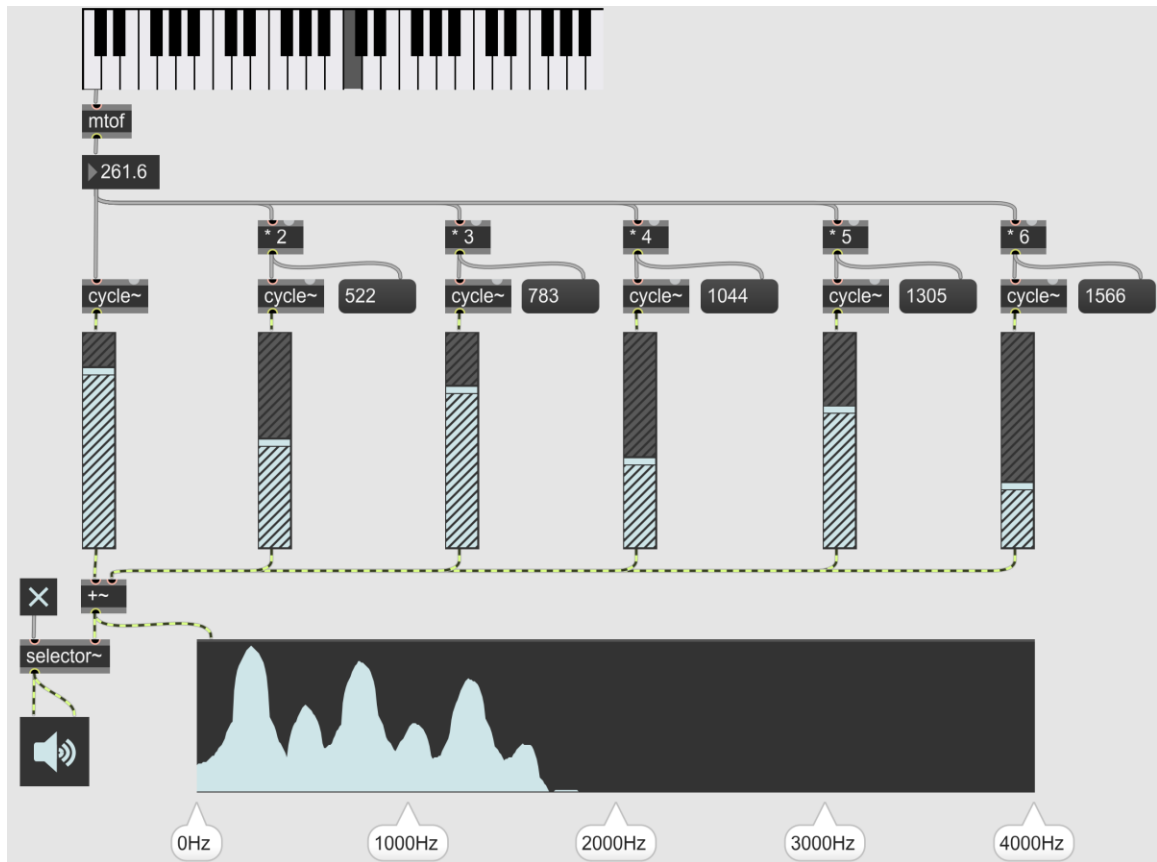
- Send multiple signals with different magnitudes to the “+~” object to sum them up



- Use a “kslider” object as the interface and set the frequencies of the signals as multiples of the base frequency

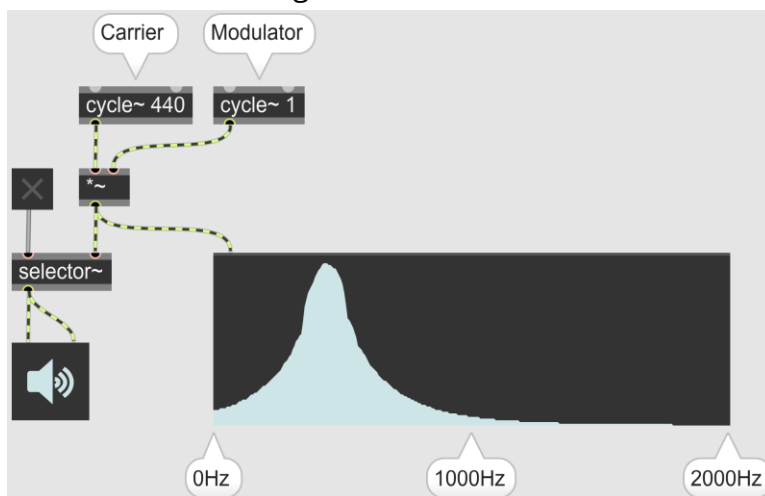


- Use the “gain~” objects for a more intuitive way to mix signals

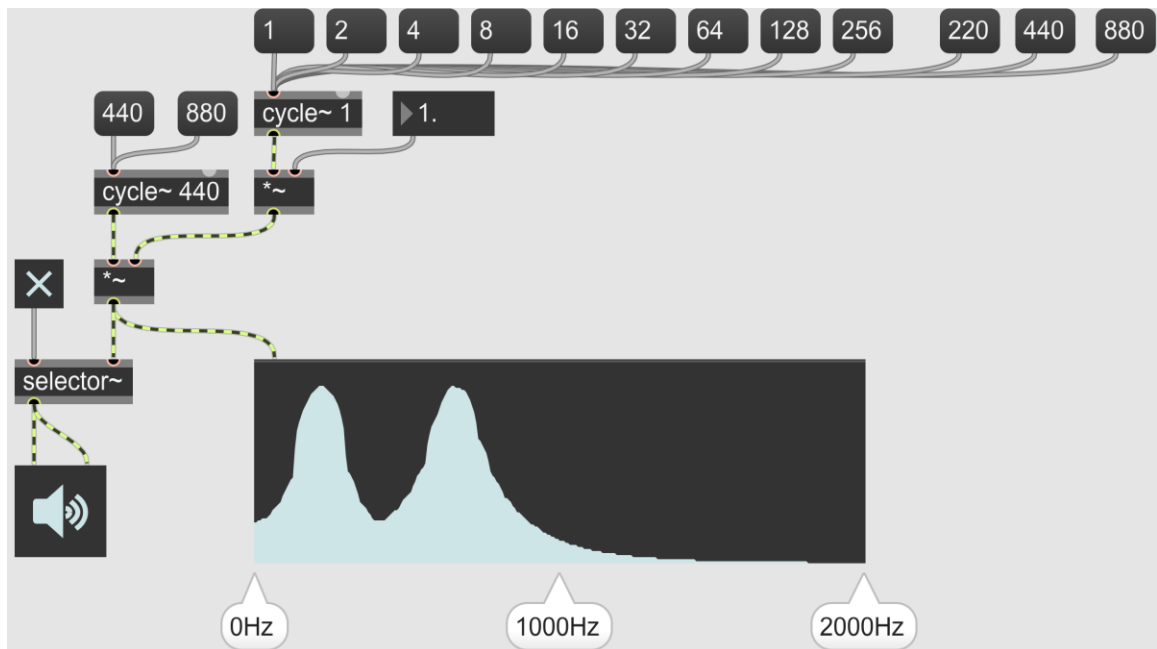


Example 3: AM Synthesis (“3_am_synth.maxpat”)

- AM stands “amplitude modulation,” where we use another signal (called *modulator*) to “modulate” the magnitude of a signal (called *carrier*)
- Amplitude modulation can be done by taking the product between a carrier signal and the modulator signal



- When the frequency of the modulator signal is high, it actually creates a separate tone of its own



- Above is an example when the carrier is 440Hz and the modulator is 220 Hz, and we see two tones at 220Hz ($440\text{Hz} - 220\text{Hz}$) and 660 Hz ($440\text{Hz} + 220\text{Hz}$)