

Signal Processing

DSP - Digital Signal Processing - on the computer.

Equalizer - changes frequency content of a sound, or controls it.

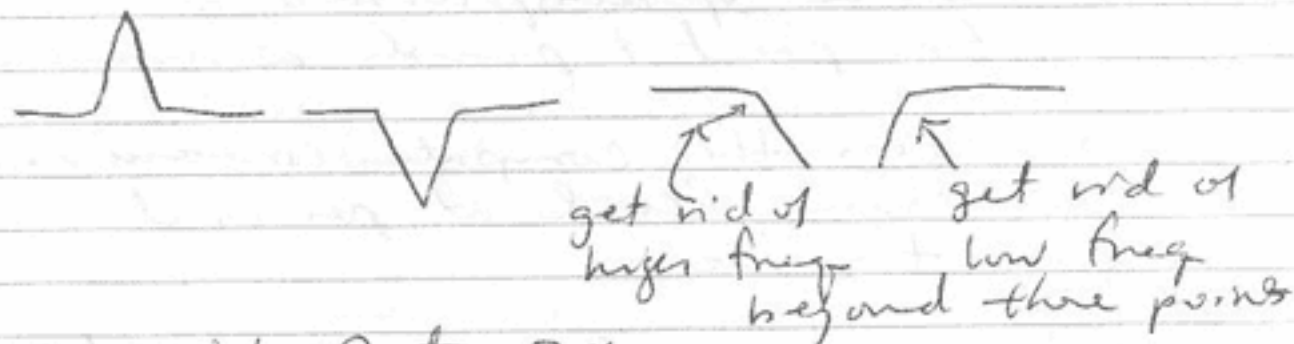
2 types: graphic
parametric

First invented to solve recording problems with microphones, etc.

Converting from high sample rate \rightarrow low sample rate - dangerous.

- causes distortion, noise because high frequencies fold over into low frequencies so are low, but we'd low sounds. \rightarrow aliasing
what to do?

- chop off high freq w/ equalizer



Nyquist Rate $2x$

44.1 kHz, thousand cycles/sec.

$44.1 \text{ kHz} / 2 = 22.05$

human range = 20 Hz - 20,000 Hz.

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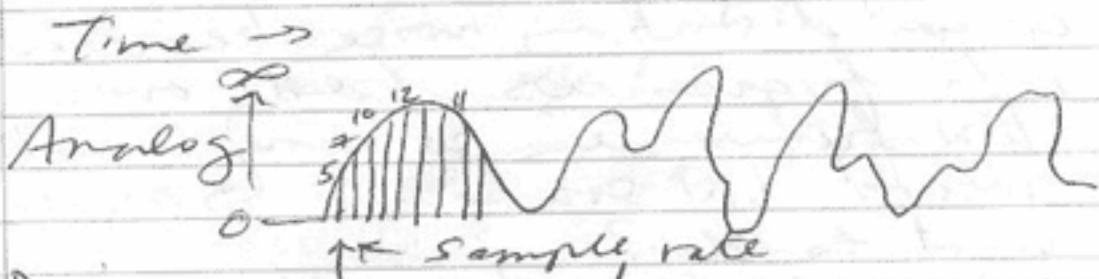
44.1 \rightarrow 22.05 \rightarrow 11 Hz

to avoid aliasing.

Nyquist rate: Sample rate should be 2x highest frequency desired i.e. 20,000 kHz human hearing.

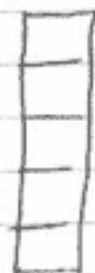
Rates:	CD audio	44.1	KHz
	Consumer DAT audio	48	KHz
	Computer Game	22.05	KHz

Converting Analog to Digital:



Digital each instance measures amount of air pressure at that time point & provides a number

how often the computer measures the volume level at per unit time: gives the Hz



bit depth

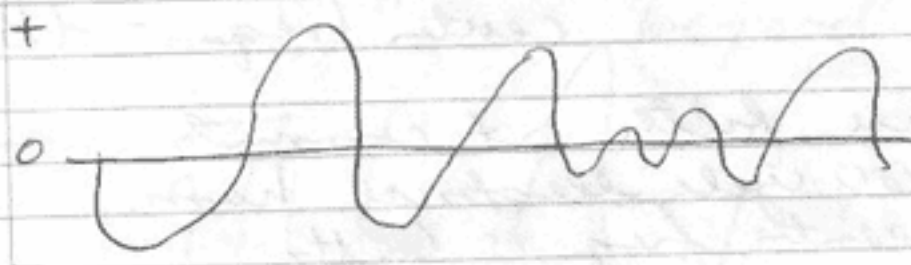
16 bits -

- gives the range of sound
- 16 bits does not exceed human discernment
- now going to 32 bit sound

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Dynamic Range: softest \rightarrow loudest



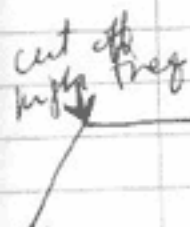
16 bits ϕ - 96 dB

Symphony 120 - 130 dB so beyond the 16 bit capability & so loses representation

Soft sounds are recorded at lower bit rates so lower quality.

Equalizers

Filters



High pass filter - lets the high frequencies pass through filters out low frequencies.

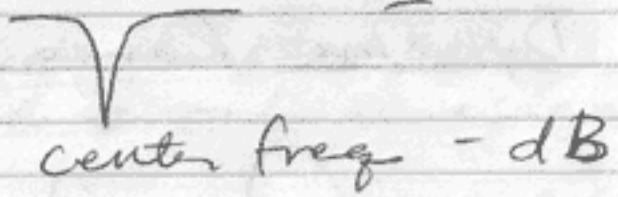
Low pass filter - lets low freq. through.

cut off frequency
input when converting to lower sampling rate.

Shelf filter - cuts at both high & low



Notch filter

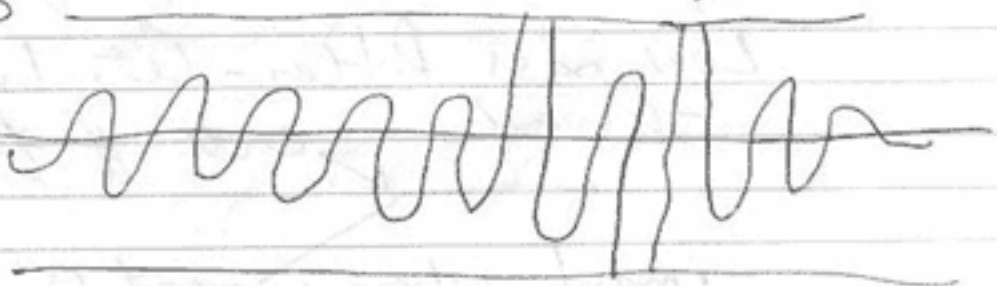


example: filter out computer noise
 or 60 cycle electrical hum.
 so center freq is 60Hz.

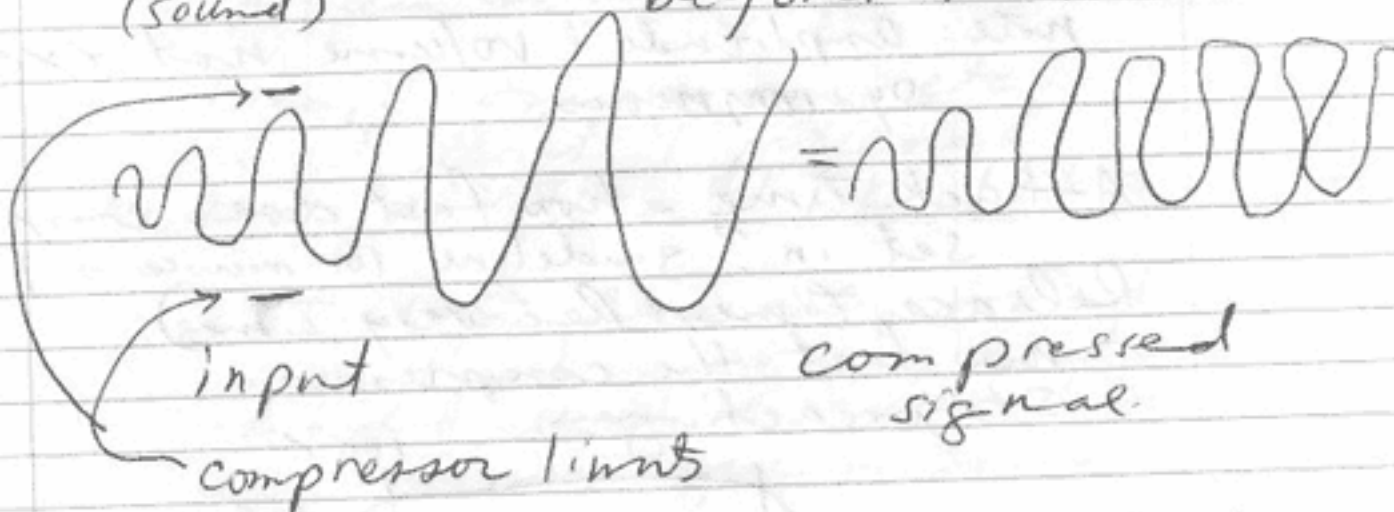
→ Filters designed to clean up noise, ^{& distortion}
 but best thing to do is to use
 the best recording equipment as
 possible with as little in the
 way towards the recording device.
 e.g. - no mixer
 - just best microphone and
 pre-amp going to
 recording device.

Boost frequency - dipping

26 dB

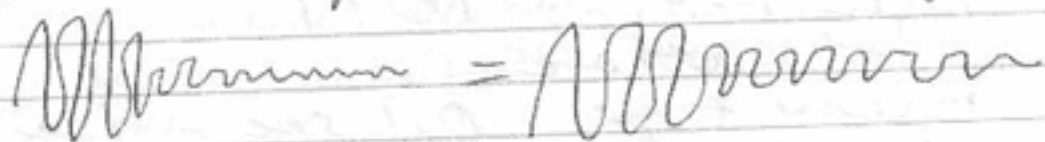


too much signal square wave distorted noise.
 An records capability
 - some effects do this for purpose.

Converter / Limiter:input signal
(sound)lowers output
beyond threshold

- needed in radios ~~so~~ became the high volume cured by out transformers. Orban perfected this for radios.

- can also bring up low input as well. such as guitar, makes less audible part more stronger & longer

Compression Ratio:

2:1

4:1

2 dB input = 1 dB output

when? when the sound gets louder than X, such as what the system can handle.

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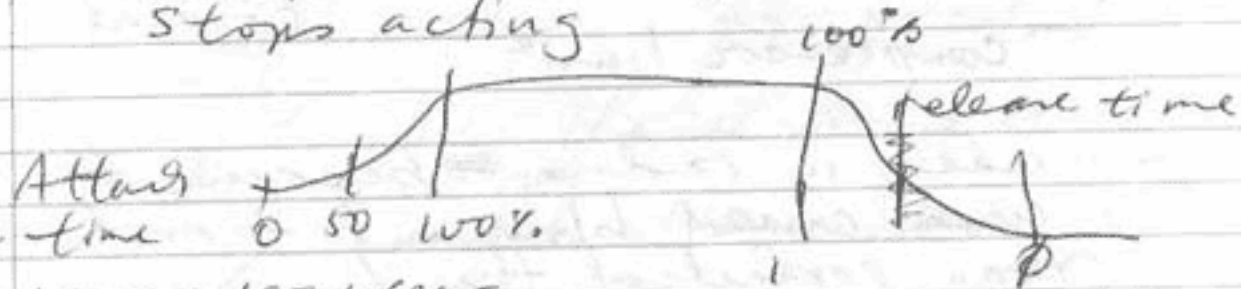
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Threshold - amount of amplitude (volume) that triggers compression.
dB

note: amplitude & volume not exactly synonymous.

Attack Time - how fast does compression set in? guideline 100 musca \rightarrow 1 msec.

Release time (Recovery Time)
how fast the compression stops acting



range: 100 μ sec - 1 msec

release time range: 0.1 sec to 2.5 - 3 sec

Limiters:

high ratio: 10:1
fast attack

release time 0.1 sec - 1 sec.

threshold - high

Pumping: takes sound with great dynamic range & causes ambient noise to be accentuated when compression is too great or threshold too low.

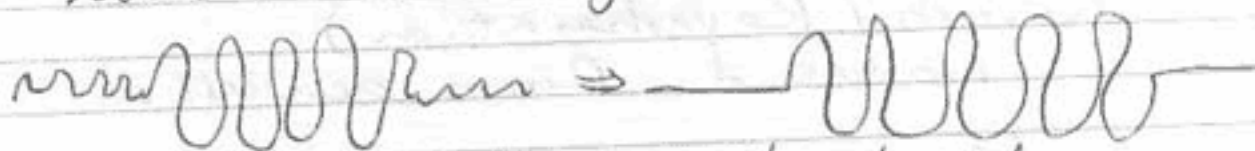
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Assign 3: take a sound file, make several copies (at least 4) + do one process to each file.

delay, compression, etc.
do at least 4 processed
→ save as AIFF, 44.1K, 16 bit.

Noise Gates: lets only sound through that reaches a certain threshold. used to get rid of noise between guitar sounds



no sound below threshold
dB level of

db = deciBell

- human scale for ~~human~~ sound pressure levels

- because of such wide range, scale is logarithmic.

0 dB = No sound

96 dB = CD loudest

increase of ~ 10 dB = double the volume
3 dB slight change noticeable.
Noise gate usually 3-7 dB, but depends on project.

Time Delay: delays output of a signal.

(Delay Line): sets signals so all reach correctly in concert hall.

Echo: delay plus fades.

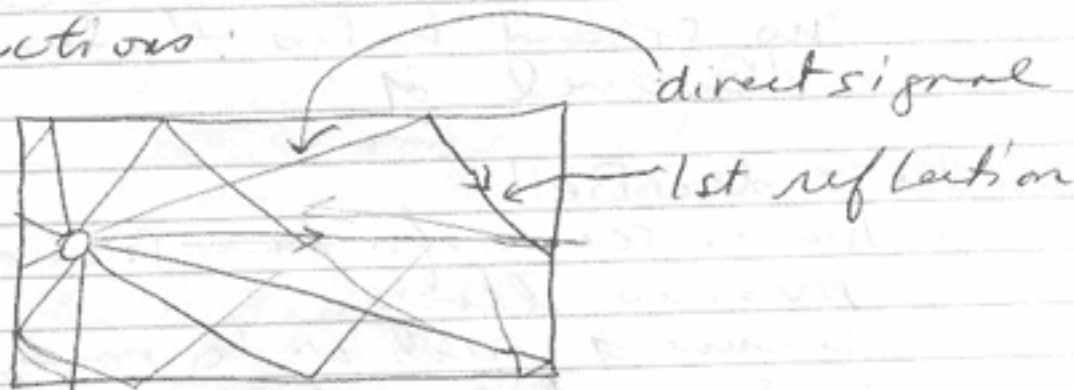
Pre Delay: point at which process starts.

Feedback: signal gets played back.

Delay time
- multiple taps

Reverb (Reverberation):
modeled Room acoustics.

Reflections:



Room Size: 5 settings in Sound Forge