Music 170 assignment 1

1. A recorded sinusoid has a sample rate of 48 kHz and a frequency of 440 Hz. What is its period in samples?

2. If a signal with 1 volt peak amplitude signal is amplified (i.e., increased) by 6 decibels, what's the resulting peak voltage?

3. What frequency is 1/2 octave above 440 Hz.?

4. If you record a signal with a word length of 8 bits, what is the theoretical signal-to-noise ratio?

5. If you generate an analog sinusoid of frequency 40 Khz, and record it at a rate of 44.1 kHz, what frequency will you hear when you play it?

6. How many octaves are there in the human hearing range (between 20 and 20,000 Hz.)?

Project: *Why you shouldn't trust your computer's speaker.* In this project, you will determine your threshold of hearing as a function of frequency: that is, for each frequency, the minimum relative level at which you can hear whether a sinusoid is present or not. This is a generalization of you hearing range: outside your hearing range the threshold is infinite (no matter how loud you play the sound you won't hear it), but you would expect your ears to be somewhat less sensitive to the extremes than the middle as well.

This has been measured for "typical" young humans with increasing reliability and accuracy ever since a set of pioneering experiments in the 1930s by Fletcher and Munson; there is a good up-to-date article on `http://en.wikipedia.org/wiki/Equal-loudness_contours`. The bottom curve in the graph is the "normal" threshold of hearing.

To do this yourself, get Pd and this patch library (`msp.ucsd.edu/syllabi/170.18f/lib/index.htm`) as shown in class, and check that you can make "sinusoid" and "output" objects in a Pd document. All you then have to do is to connect a "sinusoid" to an "output".

Then, setting the "sinusoid" frequency to 1000, try one level (in dB) after another in the "output" object until you find a level at which you don't think you hear the difference when you toggle the sound on and off (using the toggle in the "output" object). This will be a crude process and you are unlikely to be sure to plus or minus 5 dB or so where the actual threshold lies. (It might also change with practice, or if you change you sitting posture, etc.) Use your computer speaker (if it has one), or headphones.

If, at 1000 Hz, you get a value above about 50, you might not be able to follow the curve as it rises at other frequencies; if so, try to turn your computer volume up so that you can turn the "output" control down lower.

Once you have this working at 1000, try other frequencies at octaves from it (going up: 2000, 4000, 8000, 16000; and going down: 500, 250, 125, 63, 31, 16) finding anew the threshold at each frequency and plotting it. If you can't hear it at all the answer is "infinite". Graph this as best you can, and also write down whether you used the speaker on your laptop, or something else (headphones, stereo speakers, wires on the tongue, ...) How does the curve you got differ from the one in the Wikipedia link mentioned above, and why might that be?