Lab 3: Measuring waveforms

Part 1. Measuring period and frequency.

Record the sounds of the two tuning forks we have in the lab, one after another. For each sound, plot 10 cycles of its waveform using Praat. From the Praat pictures, calculate the period and the frequency of each sound. Why do we use 10 cycles not just one in calculating period and frequency? Understand what is damping.

Part 2. Measuring SNR.

Measuring the SNR (sound-to-noise ratio) of the recording of President Obama's back-to-school speech, and the SNR of your recording from lab 1. What's their difference in dB? You can estimate SNR by following these steps:

1. Load your recording into Praat;
2. Edit the sound object, make sure that View > Sound autoscaling is checked on;
3. There are two numbers shown on the left side of the sound wave window. The top one is positive and the bottom one is negative. Record the greater absolute value of these numbers. This is the maximum air pressure of the signal, P_signal, measured in Pa.
4. Select a silent portion of the recording, click on *sel* to show the selected portion only. Again, record the greater absolute value of the two numbers shown on the left side of the sound wave window. This is the maximum air pressure of the noise, P_noise, measured in Pa.
5. Calculate SNR (in dB):

$$SNR = 20*\log_{10}(P\_signal/P\_noise)$$

6. Now convert both P_signal and P_noise to dB. How do they relate to the SNR calculated in 5?

Part 3. Synthesize a song using Praat.

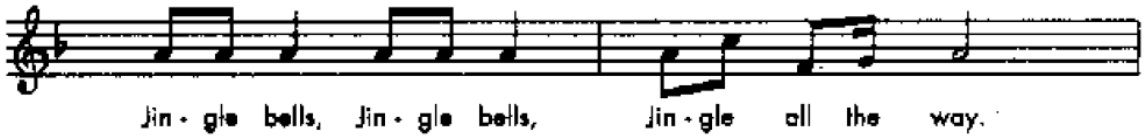
To synthesize a music note in Praat, you can use "Create Sound from formula…". Below are a few examples:

1. 1/2 * sin(2*pi*440*x): a pure tone of 440Hz frequency and 1/2 amplitude;
2. 1/2 * sin(2*pi*440*x) + 1/4 * sin(2*pi*880*x): a complex tone that has two harmonics;
3. (1/2 * sin(2*pi*440*x) + 1/4 * sin(2*pi*880*x)) * exp(-x): sound 2 with an amplitude damping coefficient of exp(-x);
4. (1/2 * sin(2*pi*440*x) + 1/4 * sin(2*pi*880*x)) * 2 * x: sound 2 with an amplitude decay coefficient a 2*x;

You may also use copy, cut, and paste when editing the sound, and the "Concatenate" and "Combine to stereo" functions under "Combine sounds".

You are asked to synthesize the tune below. You can find the frequencies of the musical notes from Table 1 at the end.

[E E E E E E E G C D E]



To make the song sound more pleasant, you can do the following: 1. add more harmonics to the tones; 2. add silences between the tones; 3. adjust the durations of the tones; 4. adjust the amplitudes of the tones; 5. create a harmony of the song (you can use the "Combine to stereo" function in Praat); 6. don't forget your imagination and creativity!

Prepare to present your song to the class in the next lab.

Appendix 1: ADSR

To adjust the amplitudes of the notes, you can try the ADSR envelope (http://en.wikipedia.org/wiki/ADSR_envelope)
Typically, when a note is played, the volume rises quickly from zero and then decays over time. The variation of the amplitude over time is divided into four segments: Attack, Decay, Sustain, and Release (ADSR). Typical ADSR envelope for the piano is shown in Figure 1 below:

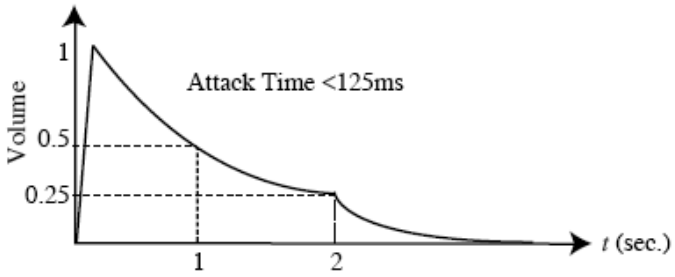


Figure 1. Typical ADSR envelope for the piano

Appendix 2:

Table 1. Frequencies of musical notes.

	OCTAVE NUMBER								
	0	1	2	3	4	5	6	7	8
C	16.3516	32.7032	65.4064	130.813	261.626	523.251	1046.50	2093.00	4186.01
C#	17.3239	34.6478	69.2957	138.591	277.183	554.365	1108.73	2217.46	4434.92
D	18.3540	36.7081	73.4162	146.832	293.665	587.330	1174.66	2349.32	4698.64
D#	19.4454	38.8909	77.7817	155.563	311.127	622.254	1244.51	2489.02	4978.03
E	20.6017	41.2034	82.4069	164.814	329.628	659.255	1318.51	2637.02	5274.04
F	21.8268	43.6536	87.3071	174.614	349.228	698.456	1396.91	2793.83	5587.65
F#	23.1247	46.2493	92.4986	184.997	369.994	739.989	1479.98	2959.96	5919.91
G	24.4997	48.9994	97.9989	195.998	391.995	783.991	1567.98	3135.96	6271.93
G#	25.9565	51.9131	103.826	207.652	415.305	830.609	1661.22	3322.44	6644.88
A	27.5000	55.0000	110.000	220.000	440.000	880.000	1760.00	3520.00	7040.00
A#	29.1352	58.2705	116.541	233.082	466.164	932.328	1864.66	3729.31	7458.62
B	30.8671	61.7354	123.471	246.942	493.883	987.767	1975.53	3951.07	7902.13