Math 399 Programming Project I - Spring 2018

Chirp Signal Generator

Please submit all project parts on the Moodle page for MAT399. You should include all necessary files to recompile, and a working executable, all in a zipped folder (one file for upload). Time-stamp determines the submit time, due by midnight on the due-date.

Due: Tuesday, January 23

Programs should compile under g++, so no Windows specific code is allowed. Please test code on a Mac in the Sound Lab to make sure that it compiles and runs and produces correct output.

Write a command line utility that produces a mono wav file that contains a sine sweep, or chirp signal of specified length in milliseconds and starting and ending frequencies. The interpolation of frequency should be either linear (type 0) or exponential (type 1). If no parameters are specified, it should default to: linear frequency interpolation, 2 seconds length, with starting frequency 110 Hz and ending frequency 440 kHz.

The output file chirp.wav should have those properties and should be a mono wav file with sample rate 44100 Hz.

With parameters specified, the program should run as:

./chirp <type> <length> $< F1 > < F2 >$

where type is 0 or 1, length is in milliseconds and F1 and F2 are in Hz.

The length should be required to be at least 1 millisecond and the starting frequency F1 should be ≥ 0 and the ending frequency F2 should be ≤ 22050, the Nyquist frequency.

To avoid clicks on playback, the chirp signal should ramp ramp down at the end for a calculated number of samples R. (The signal has a natural ramp up at the beginning since it is using a sine function.) We will take R to be at least 5 and at most 500. R should be interpolated linearly to reach 500 when the length of the chirp is 100 ms.

Output should be normalized to -6 dB.

For the exponential chirp use the curve:

$$y = be^{at} + c$$

with appropritely chosen values of the constants a, b, and c, in order to achieve the correct interpolation of F_1 and F_2 on the interval from zero to length. Use a default value for $a = \ln 2$.

Note: Please use all standard precautions when experimenting with and listening to the chirp output signals. For instance, set volume to low on all equipment, including speakers and headphones.