Worksheet – Project

Goals:

– To shift a sound file's frequency in units of octaves

Introduction:

Ever wanted to reach that high note? Or to be a bass? Well you can change the frequency of your voice with digital audio processing. First you simply have to use a fast fourier transform (FFT) to convert to the frequency domain, and then use a logarithmic multiple to shift all of the frequency bands a scaled amount.

The problem is that frequency is a linear scale, and the musical octave representation is a logarithmic scale. This means a conversion between the two needs to be used. A commonly used point of reference is 440 Hz = A4. Using this and the fact that frequency doubles for every increase in octave, we can begin to derive a formula for octave shifting. Note the chart on the back page and use the following formula as a shifting equation:

(1) $2^{\wedge}(N)*BASE = DEST$

To shift up or down an octave, you simply set N to 1 or -1 respectively. To shift up or down a note, set N to 1/12 or -1/12 also respectively. While this formula assumes frequency, you can also use the index of the frequency bands since the index is directly proportional to the frequency:

(2) $index = freq/(c)$ where c is the number of Hz per index value.

Your program should take in user input to set the octave shift, a double, and then shift the FFT bands using the inputed octave shift as N in equation 1.

Tasks:

- Ensure that you have a sound file handler of some sort coded
- Get a pre-coded FFT and learn how to implement it
- Follow the algorithm in the introduction to create a note shifting program.

Additional Information:

Note	Frequency	Note	Frequency
C2	65.41	C3	130.81
C2#	69.3	C3#	138.59
D2	73.42	D3	146.83
D2#	77.78	D3#	155.56
E2	82.41	E3	164.81
F2	87.31	F3	174.61
F2#	92.5	F3#	185
G2	98	G3	196
G2#	103.83	G3#	207.65
A2	110	A3	220
A2#	116.54	A3#	233.08
B2	123.47	B3	246.94
C4	261.63	C5	523.25
C4#	277.18	C5#	554.37
D4	293.66	D5	587.33
D4#	311.13	D5#	622.25
E4	329.63	E5	659.26
F4	349.23	F5	698.46
F4#	369.99	F5#	739.99
G4	392	G5	783.99
G4#	415.3	G5#	830.61
A	440	A5	880
A4#	466.16	A5#	932.33
B4	493.88	B5	987.77
C6	1046.5		
C6#	1108.73		
D6	1174.66		
D6#	1244.51		
E6	1318.51		
F6	1396.91		
F6#	1479.98		
G6	1567.98		
G2#	1661.22		
A2	1760		
A2#	1864.66		
B2	1975.53		