LAB 4 HOMEWORK PART 4.1

%From lab 3, a modified version of the key2sinus function:

%total duration is 2.5 seconds, last 0.1 second is silence

[f4, tt1, freq1] = key2sinus(45, 1, 0, 4000, 0.2);

%starts at 0 sec, duration is 0.2 seconds

[a4, tt2, freq2] = key2sinus(49, 1, 0, 4000, 0.2);

%starts at 0.25 sec, duration is 0.2 sec

[c5, tt3, freq3] = key2sinus(52, 1, 0, 4000, 0.2);

%starts at 0.5 sec, duration is 0.2 sec

[f5, tt4, freq4] = key2sinus(57, 1, 0, 4000, 0.2);

%starts at 0.75 sec, ends at 2.4 sec, duration is 1.65 sec

[c5, tt5, freq5] = key2sinus(52, 1, 0, 4000, 0.2);

%starts at 1.0 sec, ends at 2.4 sec, duration is 1.4 sec

[a4, tt6, freq6] = key2sinus(49, 1, 0, 4000, 0.2);

%starts at 1.25 sec, ends at 2.4 sec, duration is 1.15 sec

[f4, tt7, freq7] = key2sinus(45, 1, 0, 4000, 0.2);

%starts at 1.5 sec, ends at 2.4 sec, duration is 0.9 sec

%from part 3.2 of Lab 4:

amps = ones(1,7);

freqs = [freq1, freq2, freq3, freq4, freq5, freq6, freq7];

phases = zeros(1,7);

fs = 4000;

tStart = [0, 0.25, 0.5, 0.75, 1.0, 1.25, 1.5];

durs = [0.2, 0.2, 0.2, 1.65, 1.4, 1.15, 0.9];

maxTime = max(tStart+durs) + 0.1; %-- Add time to show signal ending

durLengthEstimate = ceil(maxTime\*fs);

tt = (0:durLengthEstimate)\*(1/fs); %-- be conservative (add one)

xx = 0\*tt; %--make a vector of zeros to hold the total signal

for kk = 1:length(amps)

nStart = round(fs\*tStart(kk))+1; %-- add one to avoid zero index

xNew = shortSinus(amps(kk), freqs(kk), phases(kk), fs, durs(kk));

Lnew = length(xNew);

nStop = nStart - 1 + Lnew; %<========= subtract 1 to start at the right

%index, add Lnew because that's the length of what you're adding

%(which is shortSinus)

xx(nStart:nStop) = xx(nStart:nStop) + xNew;

end

plotspec(xx,fs,256);

grid on; title('Lab 4 Homework Part 4.1'); xlabel('Time (sec)'); ylabel('Frequency(Hz)')

KEY2SINUS FUNCTION

function [xx,tt, freqKey] = key2sinus(keynum, amp, phase, fsamp, dur)

% KEY2SINUS Produce a sinusoidal waveform corresponding to a

% given piano key number...part 3.2

%

% xx = the output sinusoidal waveform

% tt = vector of sampling times

% keynum = the piano keyboard number of the desired note

% amp, phase = sinusoid params

% fsamp = sampling frequency, e.g., 8000, 11025 or 22050 Hz

% dur = the duration (in seconds) of the output note

%

tt = 0:(1/fsamp):dur;

freqKey = 440\*2^(-1 \* (49 - keynum)/12);

%440 is the frequency of A, which is key 49. An octave has 12 keys between.

Xphasor = amp \* exp(i\*phase);

xx = real( Xphasor\*exp(j\*2\*pi\*freqKey\*tt) );

end

PART 4.2

function [xx,tt] = makeFMexpVals(sigFMexp, dt)

amp = sigFMexp.Amp; %-- Amplitude

fc = sigFMexp.fc; %-- center frequency

b = sigFMexp.beta; %-- FM parameter

g = sigFMexp.gamma; %-- FM parameter

t1 = sigFMexp.t1; %-- starting time

t2 = sigFMexp.t2; %-- ending time

tt = t1 : dt : t2;

xx = amp\*cos(2\*pi.\*(fc\*tt + (g./(b\*tt)).\*exp(b\*tt)));

plotspec(xx,1/dt);

title('Lab 4 Homework Part 4.2');

xlabel('Time (sec)');

ylabel('Frequency (Hz)');

end