Mini-Project: Tone Removal

Background
Write a simple LabVIEW program that removes unwanted tones from a .wav file. The file
SunshineSquare.wav has had some unwanted tones added to it. Your job is to remove the
tones so you can hear the message better.

Approach
There are two steps needed to remove the tones. First, determine the frequencies of the
interfering tones, and second, filter out those frequencies.

Find the Frequencies
Use the **wavread** VI in the DSP First palette to read the .wav file. Right-click on the **path** input
to the **wavread** VI and create a constant. Right-click on this **path** constant and select **Browse
for Path**. Find the input file. Attach the output to a **TripleDisplay**. Click **Play Sound** to hear
what it sounds like.

Click the **Spectrogram** tab. Estimate the frequencies of the
tones from the spectrogram. (Hint: Use the zoom to get a good
estimate.) Convert the frequencies in hertz to digital
frequencies in $\hat{\omega}$.
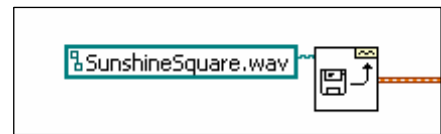
Filter the Frequencies
A weighted three-point averager is enough to remove one frequency at a time. Given the
impulse response:

$$h[n] = \{1, A, 1\}$$

find the frequency response $H\left(e^{j\hat{\omega}}\right)$ in terms of A. Find the values of A needed to remove
each of the unwanted frequencies. Once you have the correct values, the diagram below can be
used to remove one frequency at a time. The bottom left block is a **Build Array** VI. It creates
the h vector. It feeds the **filter** VI which does the filtering.

You will have to adjust the control for your
values for A. You can check the frequency
response of your filter by using **freqz** as shown.
Hint: You will have to use multiple filters.
Once you have it working, combine those filters
into a single filter. Use the **wavwrite** VI to save
your signal as a .wav file.
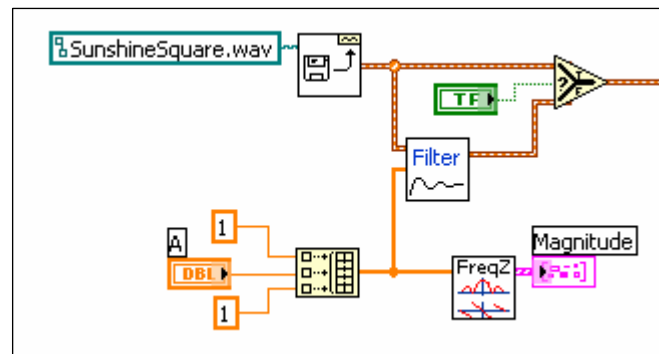
What's Due

For this mini-project you are to work on your own. You may discuss your ideas with others, but you may not share LabVIEW files. The policy stated on the Homework Procedures handout under "Responsibility" applies to this and other mini-projects.

What is due:

1. A .wav file containing your cleaned-up Sunshine Square voice clip.

2. A one-page memo describing what you did. Your memo should include:
   a. An introduction telling what the project is about. (One or two sentences should be enough.)
   b. A brief summary of what you did. Include a table listing the frequency in hertz, the digital frequency, and the value of A for each tone. Include a spectrogram and time-domain plot of the cleaned-up signal, and a **freqz** plot of your combined filter and note the sampling rate of the .wav file. Highlight any **extras** you've added. This part should take no more than half a page or so.
   c. Give your judgment on the effectiveness of this project in reinforcing the class. Justify your opinion. Only a sentence or two is expected.
   d. Provide a brief conclusion. Again, a sentence or two should be plenty.
   e. Use a memo format.

3. Print out your LabVIEW code. Selecting File→Print will start a print wizard. When you reach the "Print Contents" window, select "Icon, description, panel, and diagram." This will print out the whole works in a compact format.

Zip (i.e. rar) up the .wav file and place it in the Angel drop box. Be sure that your name is contained in the file name. Hard copy of the memo and LabVIEW printout are to be handed in at the start of class on the due date.