I400: Music Informatics
Homework 3, Due Feb. 8

As always, sumbit all code, plots, and written answers.

1. In R two vectors x and y can be "concatenated" (strung together) using the notation

   ```
   > z = c(x, y)
   ```

   the result is a vector whose length is the sum of the two lengths. Use this to create the first 10 notes of "Amazing Grace." Create the correct rhythm as well. A simple "symbolic" representation of the melody is given as:

   ```
   (g, 1/4)  (c, 1/2)  (e, 3/32)  (d, 1/32)  (c, 1/8)  (e, 1/2)  (d, 1/4)  (c, 1/2)  (a 1/4)  (g, 1/2)
          +5        +4         -2         -2        +4        -2        -2        -3       -2
   ```

   where the letters are note names and the numbers are lengths in musical units. Your actual note lengths must be proportional to the lengths I have given. Choose the note lengths so that a 1/4 gets 1 second, so the lengths of the notes will be 1 sec, .5 secs, etc. To get the frequencies, I have indicated the difference in "half steps," between each pair of notes. It is not important that you begin on g, as indicated, but only that you observe the correct interval relations using equal tempered tuning.

2. Add a "drone" (long held notes of c and g) to your melody. The drone should last for the entire length of your melody and sound at the same time. Remember that two sound signals added together appear as if they are sounding at the same time.

3. Create a 5 second sine tone with pitch vibrato, as follows:

   (a) Create and plot the function $f(t) = 440 + 5\sin(2\pi 4t)$. The function should last for 5 seconds and use 8000 samples per second for a total of 40,000 values. This function shows how frequency will change over time.

   (b) Create and play the sound sin(cumsum(2*pi*f(t)/SR)). If done correctly, you should hear a note with vibrato.

   (c) Change the rate of the vibrato (the speed of pitch oscillations) to 3 Hz and play your sound

   (d) Change the vibrato "width" (the amount of frequency change from 440Hz) to 10 Hz and play your sound.