Tune-Up Tuesday for September 11, 2018

(a) Copy, paste and run the Matlab code from slide 1-14 to generate the cosine signal $x(t) = \cos(2\,\pi\,f_0\,t)$ with $f_0 = 440$ Hz and play it as an audio signal for 3 seconds at the sampling rate of $f_s = 8000$ Hz:

```
% (a) 'A' note on Western scale in fourth octave (A4) @ 440 Hz
%     See https://en.wikipedia.org/wiki/Piano_key_frequencies
f0 = 440;                   % note 'A4'
fs = 8000;                  % sampling rate
Ts = 1/fs;                  % sampling time
t = 0 : Ts : 3;             % 3 seconds
x = cos(2*pi*f0*t);
```

(b) Add to the code in (a) to generate a new signal $y(t) = \cos(2\,\pi\,f_0\,t)\cos(2\,\pi\,f_1\,t)$ with $f_1 = 110$ Hz by using the same sampling rate of $f_s = 8000$ Hz.

```
% (b) Multiply cosine @ 440 Hz and cosine @ 110 Hz
% Modified the code from the left side of lecture slide 3-3.
f1 = 110;
x1 = cos(2*pi*f1*t);
y = x .* x1;
```

(c) Add to the code in (b) to playing $y(t)$ as an audio signal.

```
% (c) Play y(t) at sampling (playback) rate of 8000 Hz.
%     I hear two notes/tones.
%     The product can be written as a sum of two cosines.
%     Using the result from lecture slide 3-2,
%     y(t) = 0.5 cos(2 pi 330 t) + 0.5 cos(2 pi 550 t)
%     Tones at 330 Hz (E4) and 550 Hz (C#5) are harmonics of 110 Hz
%     See https://en.wikipedia.org/wiki/Piano_key_frequencies
sound(y, fs);
```

(d) Copy and paste your code for (c) into the Tune-up Tuesday #2 page on Canvas.

```
% Although not asked, we plot one period of y(t) in Matlab.
% Modified the code from the right side of lecture slide 3-3
% The product of two sinusoids produces frequencies f0+f1 and f0-f1
ffund = gcd(f0+f1, f0-f1);
Tfund = 1/ffund;
n = round(Tfund / Ts);            % Tfund / Ts isn't an integer.
plot( t(1:n), y(1:n) );
```