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diary on
format compact
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%EEL3135 Fall 2018
%Lab 2 Part 1

%1.1
type synthesize

function [xx, tt] = syn_sin(fk, Xk, fs, dur, tstart)

%SYNTHESIZE Function created for lab2.1.
%Function based on given instruction 1.1.
%The function will take in two vectors of the same length: a vector of
%frequencies and a vector of phasors, along with numbers for sampling
%frequency fs, duration dur, and start time tstart. Then, it will generate
%a sinusoid for each frequency and phasor in the two vectors and add them
%together. Finally, it will return the sum of the sinusoid.
%Note: Must write the function with one loop.

%{
SYN_SIN: Synthesize a sum of cosine waves.
    Input Args:
        fk: vector of frequencies of the sinusoids (Hz)
        Xk: vector of complex amplitude (phasor form)
        fs: sampling frequency (Hz)
        dur: duration of the output waveform (seconds)
        tstart: start time of the output waveform (seconds)
    Output:
        xx: synthesized sum of sinusoids waveform
        tt: time vector used in synthesis
    Usage:
        [xx, tt] = syn_sin(fk, Xk, fs, dur, tstart)
    Note: fk and Xk must be the same length
        Xk(1) corresponds to frequency fk(1)
        Xk(2) corresponds to frequency fk(2)
%}

%If no duration time, no plot to be graphed.
if dur==0
    display('Error: No duration time');
    return
end

%If there is a missing or negative tstart time, set it to zero.
if (tstart<=0)
    tstart=0;
end

%Check if fk and Xk are the same length, if not output a error.
if(length(fk) ~= length(Xk))
    display('Error: There is not an equal number of frequencies and
amplitudes.');
    return;
end
```

```
%Initialize T vector to be zero.
T=zeros(1,length(fk));
%The period.
%T=1/fk;
%Time vector.
tt = tstart:1/fs:dur;

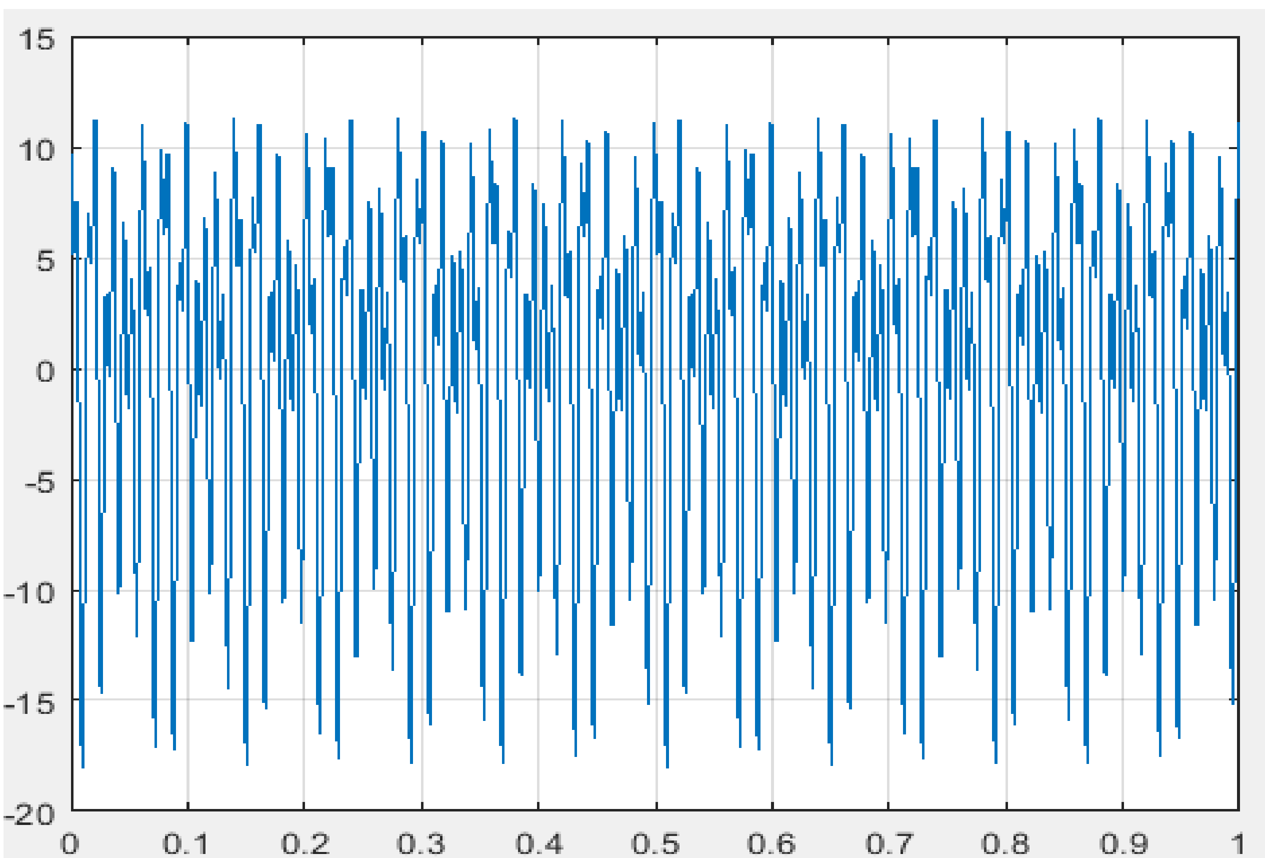
%Initialize xx vector to be zero.
xx=zeros(1,length(t));

%Require Loop
n=length(Xk);
for k=1:n
    %Xk(k) corresponds to frequency fk(1) or to frequency fk(2)
    xx = xx + real(Xk(k)*exp(j*2*pi*fk(k)*tt));
end

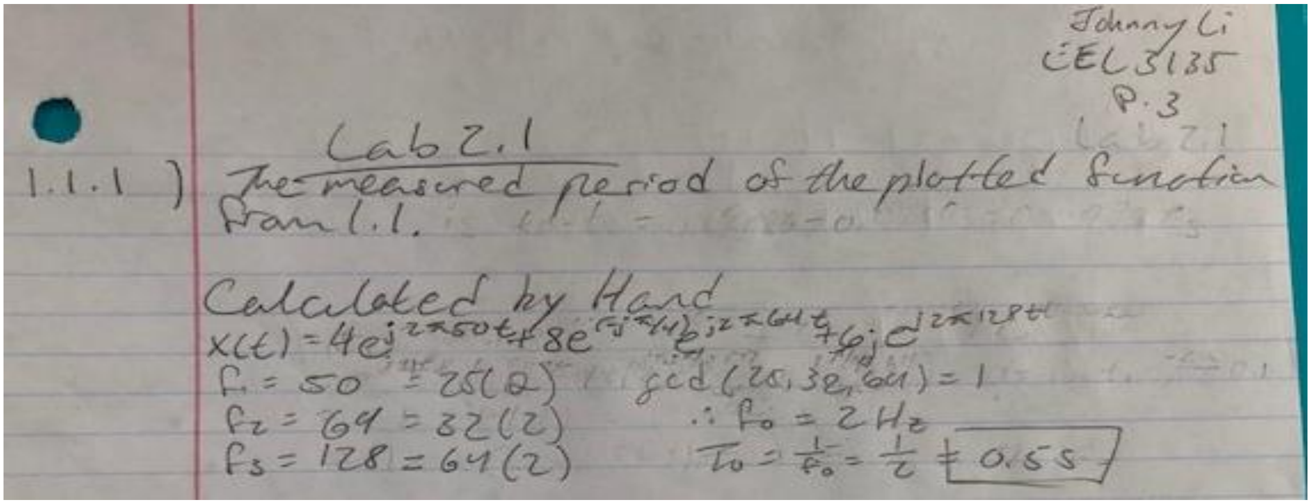
%Plot result on gird
plot(tt,xx);
grid on;

end

[x,t] = synthesize([50,64,128], [4,8*exp(-j*pi/4) , 6j ],8000,1,0)
```



%1.1.1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P.3

Lab 2.1

1.1.1) The measured period of the plotted function from 1.1.

Calculated by Hand

$x(t) = 4e^{j2\pi 50t} + 8e^{(j\pi/4)}e^{j2\pi 64t} + 6j e^{j2\pi 128t}$

$f_1 = 50 = 25(2)$ $\quad gcd(25,32,64) = 1$

$f_2 = 64 = 32(2)$ $\quad \therefore f_0 = 2 Hz$

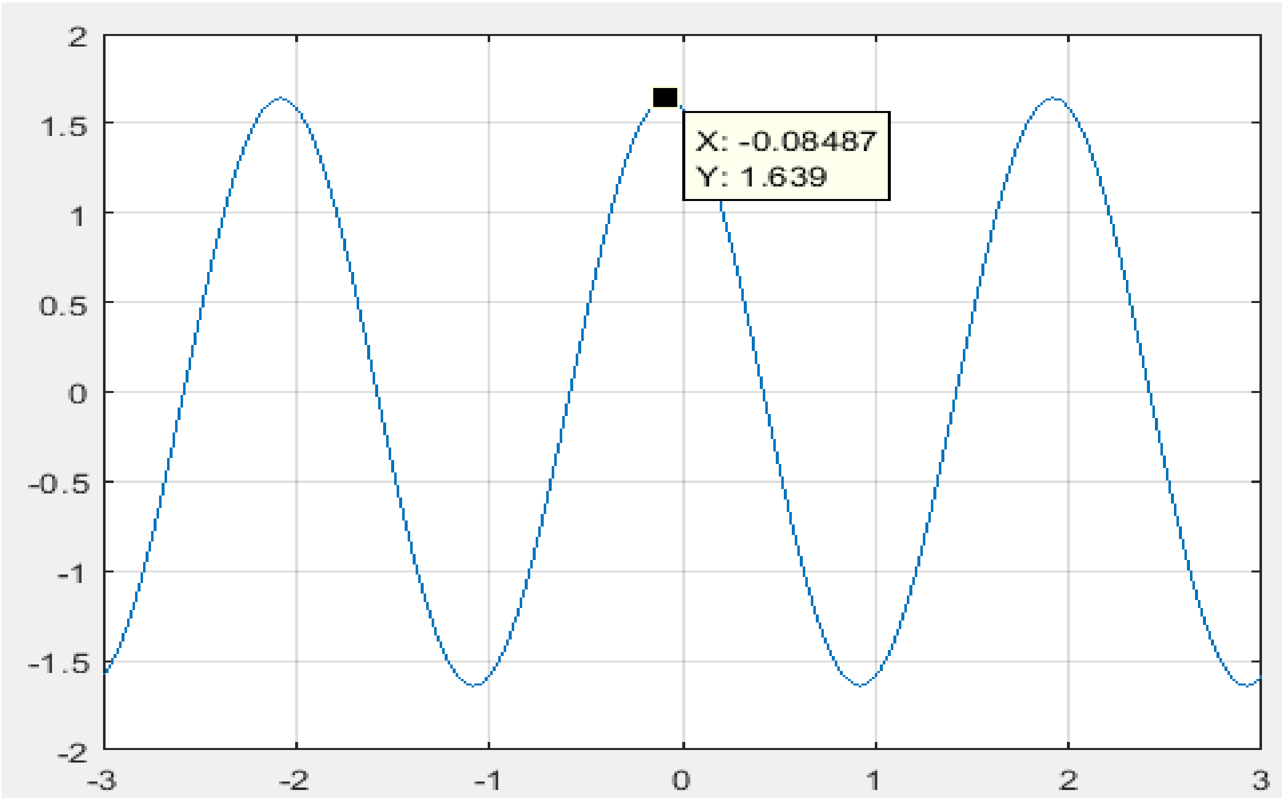
$f_3 = 128 = 64(2)$ $\quad T_0 = \frac{1}{f_0} = \frac{1}{2} = \boxed{0.5 s}$

```
%1.1.2

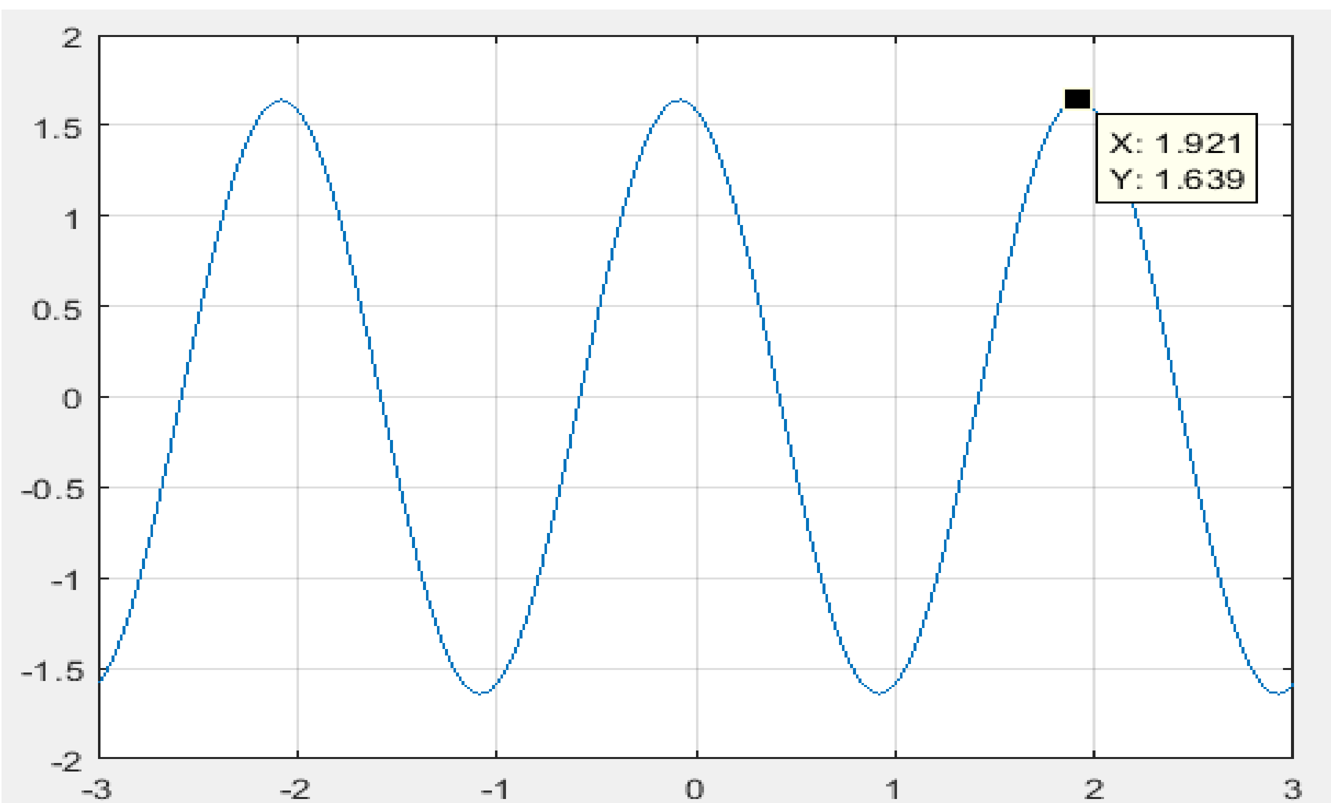
%Compare and explain the period of x to the periods of the three individuals
%signals that makeup x.
%The frequency given include 50, 64, and 128 Hz, therefore the given
%periods include 0.02, 0.0166, and 0.0078s. The fundamental frequency is
%given by gcd of (50,64,128)=(2)(25,32,64)=1 thus fo = 2Hz, To = 0.5 sec,
%the period of x. The individual periods are smaller than the period of x.

%Question: Why is the period of x longer than the individual sinusoids that
%made it up?
%The period of x is longer than the individual sinusoids that makes it up
%because the function is the sum of the sinusoids, thus the addition of the
%inverse of the frequencies produces a longer period.


%1.2.1
%The signal will have the same fundamental frequency since the signals has
%the same angular frequency pi, which translate to 1/2 Hz due to wo=2pi/fo.
%The output has the same frequency of the signals that makes it up.
%The period of the generated signal will be T=1/fo but since range need to
%cover three periods, multiply by 3, thus To=3*(1/(1/2)) = 6s.
%The sampling frequency will remain the same as the previous one. The start
%time will encompass half the duration, part negative and positive equally.
%The function is shown below.
[x,t] = synthesize([1/2,1/2,1/2], [2,2*exp(-j*1.25*pi), (1-j) ],8000,3,-3)
```



%1.2.2



1.2.2) From the data point on the plot, the

$\boxed{\text{Amplitude} = 1.639}$

The period of the function is from one peak to another: $x_2 - x_1$ where x_n is the time(s) on the x-axis.

$x_1 = 0.06257$ $\quad T = x_2 - x_1 = 1.921 + (t\ 0.08487)$

$x_2 = 2.066$ $\quad = 2.00587$

$\therefore f = \frac{1}{T} = \frac{1}{2.00363} \approx \boxed{\frac{1}{2}\,Hz = \text{frequency}}$

$\text{Phase} = wt_s = \frac{2\pi t_s}{T} = \frac{2\pi(0.08487)}{2.00363} = -0.08472\pi$

$\boxed{\phi \approx 0.08\pi} = 0.266\ \text{rad}$

```
%1.2.3
%Use the phasor addition theorem.
%Measure the period T.
t=6;
x1=2*exp(j*pi*t);
x2=2*exp(j*pi*(t-1.25));
x3=(1-j)*exp(j*pi*t);
xs=x1+x2+x3;
zprint(xs);
 Z =     X    +     jY     Magnitude    Phase    Ph/pi   Ph(deg)
       1.586      0.4142       1.639    0.255    0.081    14.64

%The amplitude and phasor have approximately similar value.
```