**Exercise #8: Discrete Fourier Transform (DFT II).**

**Until: 10/6**

1. Let x = 3\*sin(2\*pi\*2+pi/8)
   1. Sample this signal with 20 points in 1 second (e.g. use t=0:1/20:1-1/20)
   2. Compute fanalysis
   3. Plot the sampled signal (use stem(fanalysis, x(t))
   4. Compute the **scaled** DFT X using matlab
   5. Plot the abs(X) and verify you see a frequency in 2Hz of with amplitude of 3
   6. Compute the phase of frequency 2 and verify with matlab ‘angle’ function
   7. What should be the value of X[0] (e.g. X(1) in matlab)? verify
2. How would X[0], X[1], X[2], X[3], X[4] values in question 1 change if you sample x with 20 points in 2 seconds? Hint: compute fanalysis
3. The matlab code below averages 100 signals of a 2 Hz sinus sampled over one second. Each signal has a random phase from 0 to 2\*pi
   1. Compute the DFT of the averaged signal and plot the spectrum by plotting abs(X)
   2. Why the result still have a 2 Hz frequency? (hint: think about the linearity of the DFT)
   3. Why is the amplitude reduced?
   4. Compute the phase of the average signal at the 2 Hz frequency
4. Let x be a real signal of which X is its DFT (unscaled). You know that x was sampled with 20 points over 1 second. You are told that: X[0]=0, X[3] = 20, X[5] = 30-40i. all other first 10 X values are zero
   1. Write the X values from 11 to 19 (e.g, X[10],X[11],… ,X[19])
   2. Write x as sum of sinus and cosine functions
   3. (Relatively hard, bonus of 5 points:) Assume now that X[0] = 40.Write x as sum of sinus and cosine functions

**Code:**

t=0:0.01:1-0.01;

x=sin(2\*pi\*t\*2);

figure; plot(t,x); hold all;

for i=1:100

p=rand\*2\*pi;

x = x+sin(2\*pi\*t\*2+p);

end

x=x/i;

plot(t,x)