**Exercise #7: Discrete Fourier Transform (DFT)**

1. Let X=3+4i be a complex number.
   1. Write it in polar form and in Euler form
   2. Repeat the above for 3-4i
2. In class we showed how to “manually” compute X[1] for the function: x=3\*sin(2\*π\*2\*t) + 2\*sin(2\* π\*3\*t)
   1. Repeat this procedure for X[0] and X[2]
   2. Verify your answer using matlab (e.g. run: X = fft(x))
3. Assume you computed a 8 points DFT in one second on signal x to obtain X. what you expect the X values to be if (verify with fft in matlab):
   1. x=2\*sin(2\*pi\*t\*2)
   2. x=3\*cos(2\*pi\*t\*3)
   3. x=2\*sin(2\*pi\*t\*2)+3\*cos(2\*pi\*t\*3)
   4. 5\*sin(2\*pi\*t\*5); (note the sampling rate…)
4. Let x= [2.7716 1.4142 -0.7716 -0.7071 1.1481 1.5858 -0.8519 -3.5355 -2.7716 1.4142 4.7716 3.5355 -1.1481 -4.4142 -3.1481 0.7071] sampled over t=0:1/16:1-1/16 seconds
   1. Plot x versus time
   2. Compute the DFT (use matlab fft function and remember to normalize) and plot the real and imaginary parts as a function of freeuncy (e.g. the values in t)
   3. Compute the phase of each signal and plot a graph of phases versus frequency
   4. Write the x as a sum of sin and cos functions
5. Let x🡨🡪X be a DFT pair. Describe how will X change if:
6. We add to x a constant ***a***
7. We multiply x by a real number ***b***

(check your answers with matlab on some simple function…)