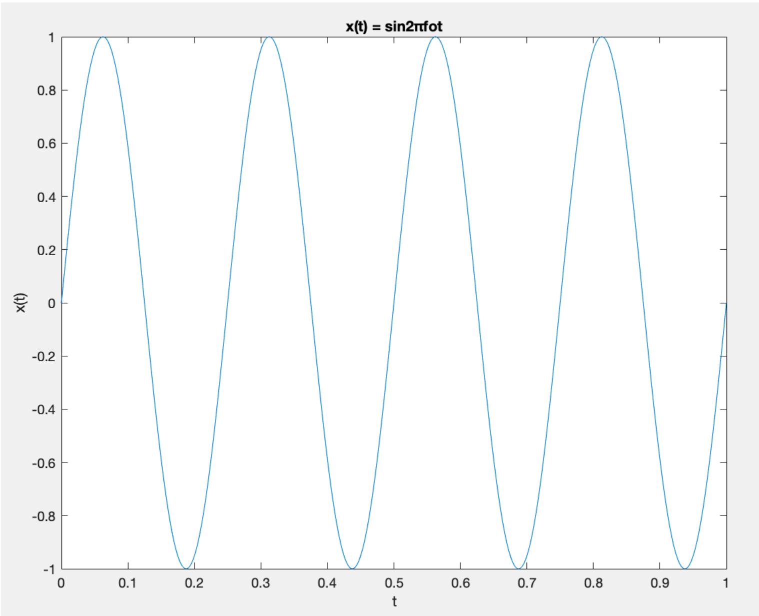
Xiaobin Zhuang - 300519184
ECEN220 Lab 1
27/07/2020

Objectives

The primary object of this lab was to be familiar with the signals properties by using MATLAB. And also do the convolution of LTI systems.

Questions

Q1 a): By running these codes, we got the graph of x(t) over a time interval of 1 second, with 0.001 resolution. The graph shown below:




```
%Question 1
%(a)
t = 0:0.001:1;
f0 = 4;
xt = sin(2*pi*f0*t);
plot(t,xt);
```

Fig. 1

b): By doing the Matlab code on the right, And combine with the code of question a. We can get the graph shown in fig. 2.

In fig.2, blue line represent x(t), red one represent x1[n] and yellow one represent x2[n]. In the graph, we can see every 8 red points are a period(N=8) of x1[n], and every 5 yellow points are a period(N=5) of x2[n].

```
%(b)
n1 = 1:1:32;
fs1 = 8*f0;
ts1 = 1/fs1;
x1n = sin(2*pi*n1*f0*ts1);
hold on
stem((n1*ts1),x1n)
n2 = 1:1:10;
fs2 = 5*f0/2;
ts2 = 1/fs2;
x2n = sin(4*pi*n2*f0*ts2);
hold on
stem((n2*ts2),x2n)
```

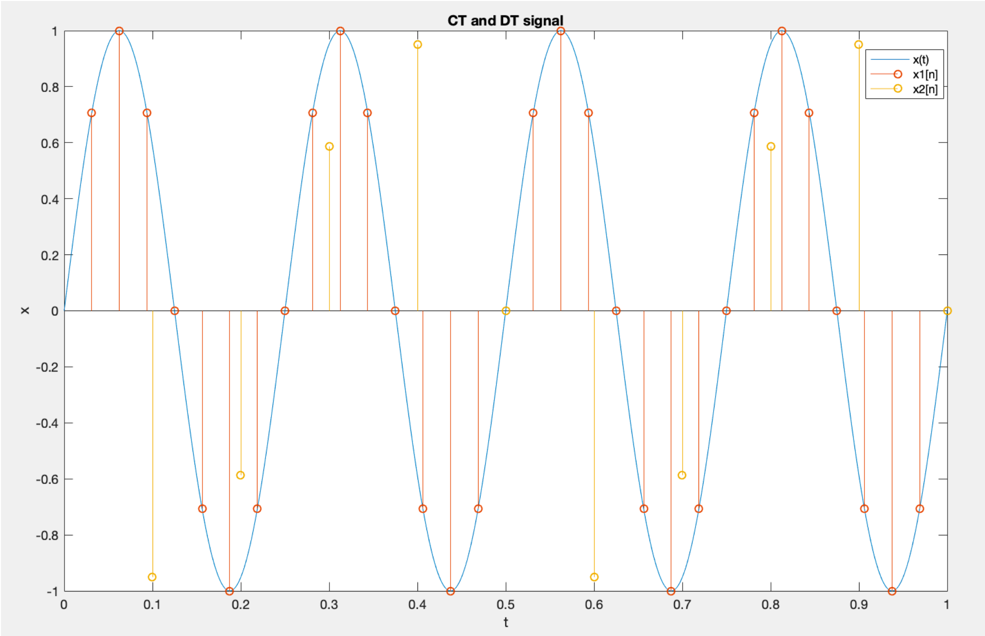


Fig. 2

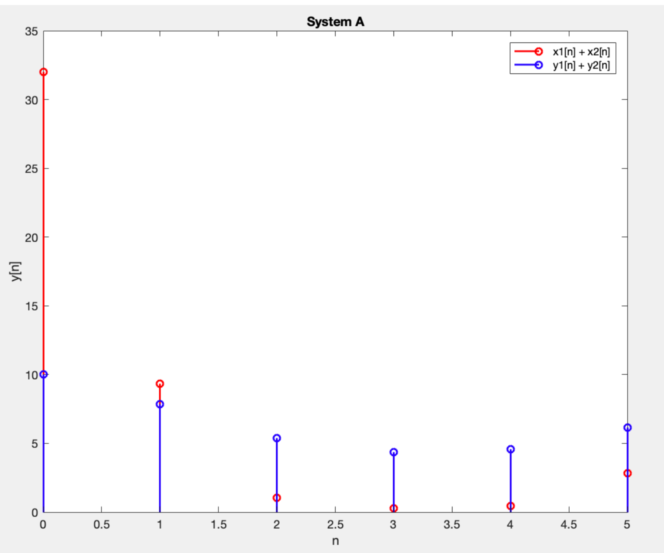
c): For x(t), T0 = 2π / Wo = 2π / 8π = 1 / 4

For x1[n] = Wo / 2π = 2π / 8 / 2π = 1 / 8 = m / N, m = 1, N = 8, x1[n] repeats after m = 1 cycle of x(t) in step with each other.

For x2[n] = Wo / 2π = 4π / 5 / 2π = 2 / 5 = m / N, m = 2, N = 5 x2[n] repeats after m = 2 cycles of x(t) in step with each other.

As we can see in fig.2, blue line represent x(t), red one represent x1[n] and yellow one represent x2[n]. We can see that every 8 red points are a period(N=8) of x1[n], and every 5 yellow points are a period(N=5) of x2[n].

Q2:

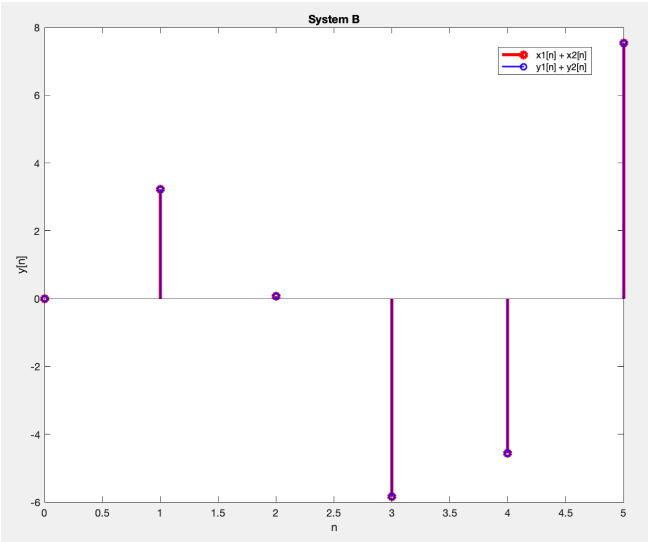



```
%Question 2
%System A
n=0:5;
a = 2;
b = 3;
x1n = 0.8.^n;
x2n = cos(n);
z = a * x1n + b * x2n;                    %
yA1 = 2.^z;                           %then
stem(n,yA1,'r', 'linewidth',1.5)
hold on
y1 = 2.^(0.8.^n);             %put two
y2 = 2.^(cos(n));
yA2 = a * y1 + b * y2;         %then
stem(n,yA2,'b','linewidth',1.5)
hold off
```

fig. 3

For a linear system, there are two properties: additivity and homogeneity. Put them together: ax1(t) + bx2(t) → ay1(t) + by2(t). ax1[n] + bx2[n] → ay1[n] + by2[n]

According to this properties, we firstly added input two signals, then went through system A, and plot a graph. Secondly, we let these two signal went through system A individually, then added them together, and plot a graph as well.
We can see in fig.3, input(red line) is a weighted sum of several signal, the output(blue line) is the superposition (weighted sum) of responses to each of the signals. So system A is a linear system.

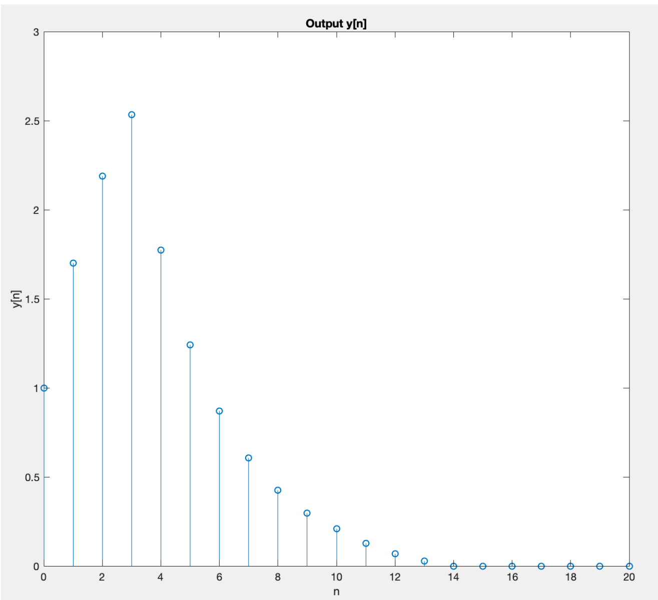



```
%System B
n=0:5;
a = 2;
b = 3;
x1n = 0.8.^n;
x2n = cos(n);
z = a * x1n + b * x2n;          %
yB1 = n.* z;                    %
stem(n,yB1,'r', 'linewidth',3)
hold on
y1 = n.* (0.8.^n);       %put two
y2 = n.* (cos(n));
yB2 = a * y1 + b * y2;      %ther
stem(n,yB2,'b','linewidth',1.5)
hold off
```

fig. 4

For system B, we follow the same procedure with system A. The output graph shown in fig.4, which prove system B is linear as well.

Q3: a)




```
%Question 3
n = 0:10;
n1 = 0:20;
hn = 0.7.^n;
oldparam = sympref('HeavisideAtOrigin',1);
u1 = heaviside(n);
u2 = heaviside(n-4);
xn = u1-u2;
y = conv(hn,xn);
stem(n1,y)
```

fig. 5

In this question, we used heaviside() to return a step function u(t). However, by using this function, the first value of u(t) wasn't 1, so we have to write

oldparam = sympref('HeavisideAtOrigin',1);

to change it into 1.

We set n1 and use it to plot instead of using n, because the X value must have same length with Y value.

Output y[n] shown in fig.5.

b)

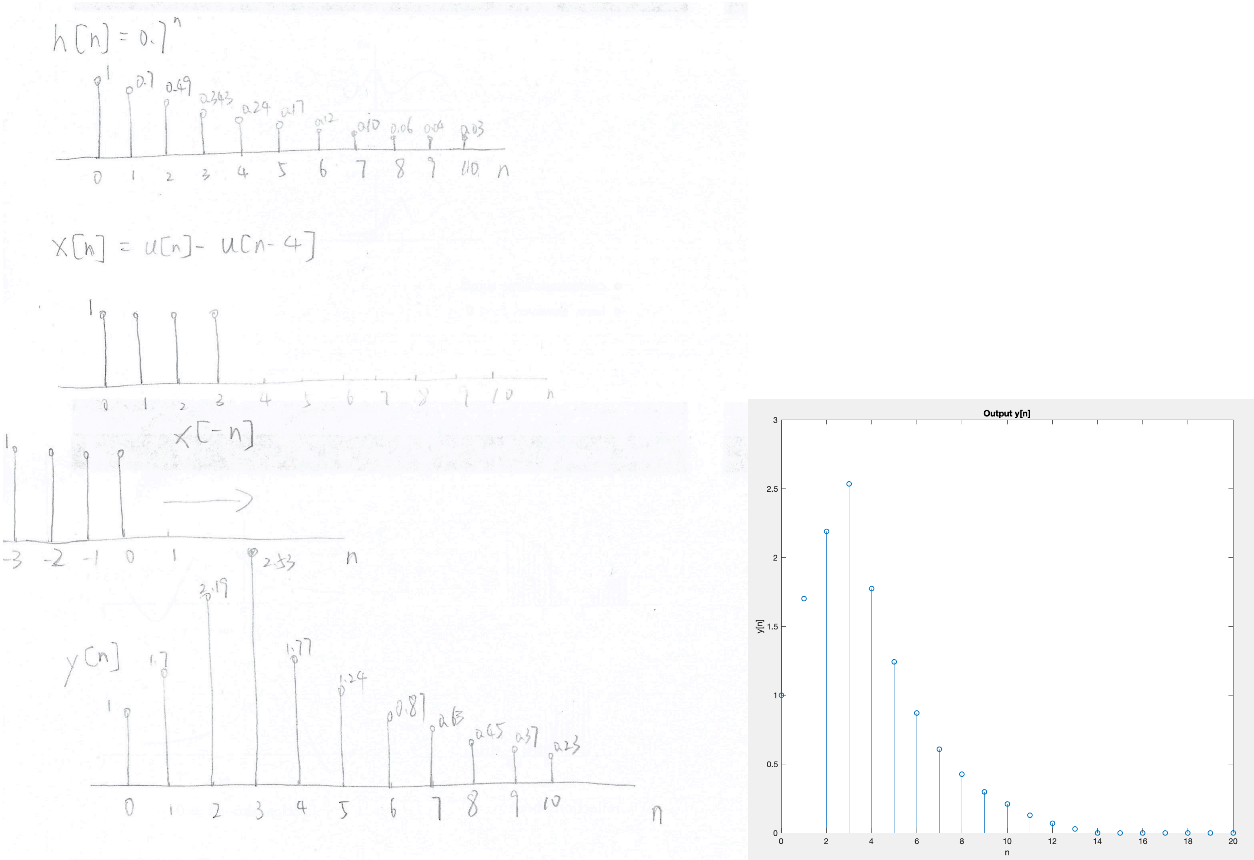


fig. 6

Solving the convolution by hand, the result shown in fig. 6. It is same with the result of MATLAB.