SS EXPERIMENT LAB 5

TITLE: To determine the convolution sum and verify it through MATLAB.

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OBSERVATION: I learned to find the convolution sum by using MATLAB, which was used to verify the analytical solution.

Sigfold Function:

```
function [y,n] = sigfold(x,n)
y = fliplr(x); n = -fliplr(n);
end
```

Sigmult Function:

```
function [y,n] = sigmult(x1,n1,x2,n2)

n = min(min(n1),min(n2)):max(max(n1),max(n2));
y1 = zeros(1,length(n)); y2 = y1;
y1(find((n>=min(n1))&(n<=max(n1))==1))=x1;
y2(find((n>=min(n2))&(n<=max(n2))==1))=x2;
y = y1 .* y2;
end
```

Sigshift Function:

```
function [y,n] = sigshift(x,m,k)
n = m+k; y = x;
end
```

A. Determine analytically the convolution $y(n) = x(n) * h(n)$ of the following sequences, and verify your answers by writing a MATLAB script and inbuilt functions.

1. $x(n) = \{2, -4, 5, \underset{\uparrow}{3}, -1, -2, 6\}$, $h(n) = \{1, \underset{\uparrow}{-1}, 1, -1, 1\}$

Ans 1

$x(n) = \{2, -4, 5, 3, -1, -2, 6\}$

$h(n) = \{1, -1, 1, -1, 1\}$

$y(n) = x(n) * h(n)$

$y(n) = \sum_{k=-\infty}^{\infty} x(k)\, h(n-k)$

$h(-k) = \{1, -1, 1, -1, 1\}$

$y(0) = \sum_{k=-\infty}^{\infty} x(k)\, h(-k)$

$= 2\times 1 - 4\times -1 + 5\times 1 + 3\times -1 + 1\times -1$

$= 2 + 4 + 5 - 3 - 1$

$y(0) = 7$

$h(1-k) = \{1, -1, 1, -1, 1\}$

$y(1) = \sum_{k=-\infty}^{\infty} x(k)\, h(1-k)$

$= -4\times 1 - 1\times 5 + 3\times 1 + 1\times -1 - 2\times 1$

$= -4 - 5 + 3 + 1 - 2$

$y(1) = -7$

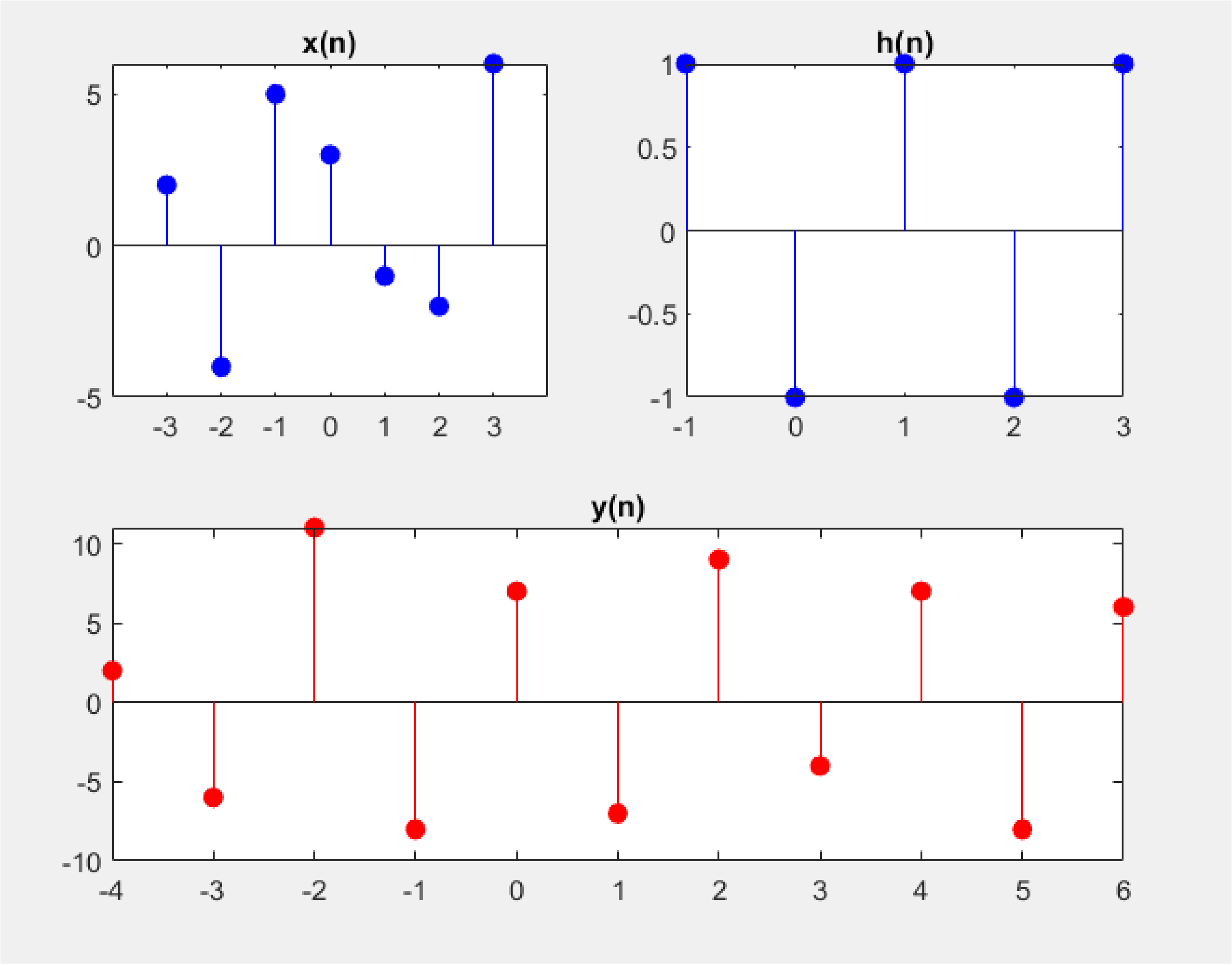
$h(-1-k) = \{1, -1, 1, -1, 1\}$

$y(-1) = 2\times -1 - 4\times 1 + 5\times -1 + 3\times 1$

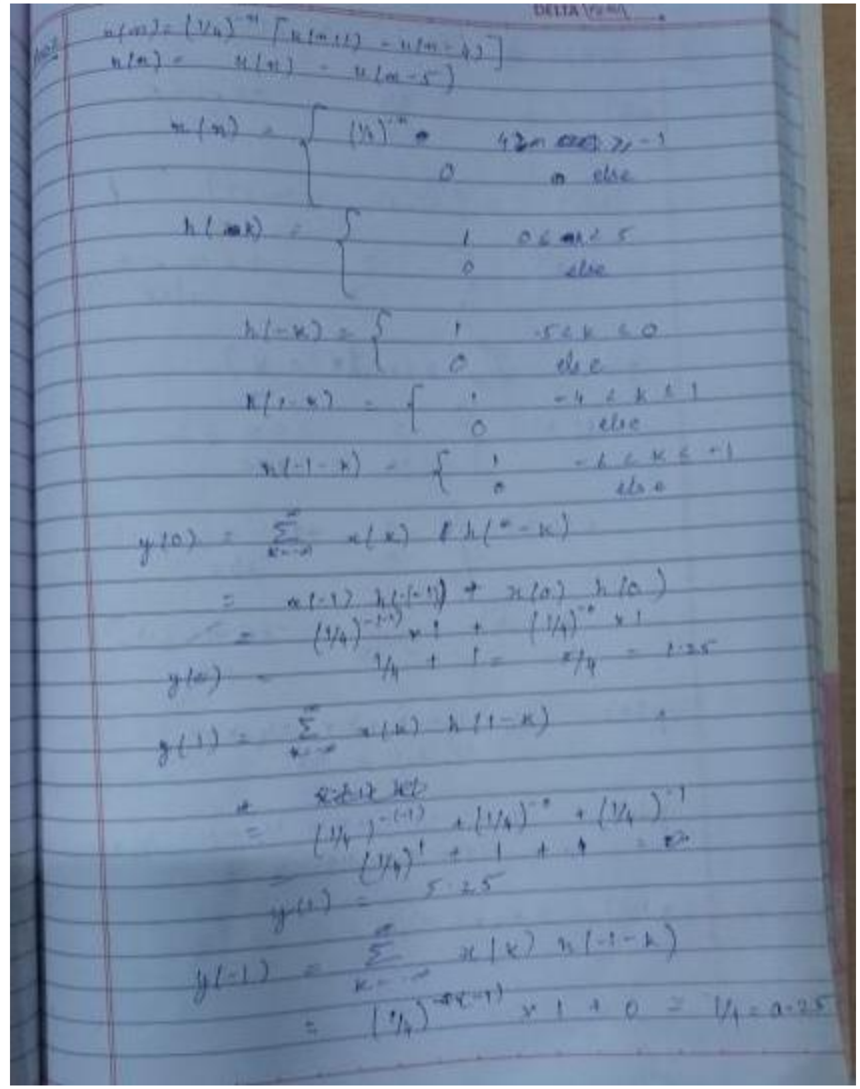
$= -2 - 4 - 5 + 3$

$y(-1) = -8$

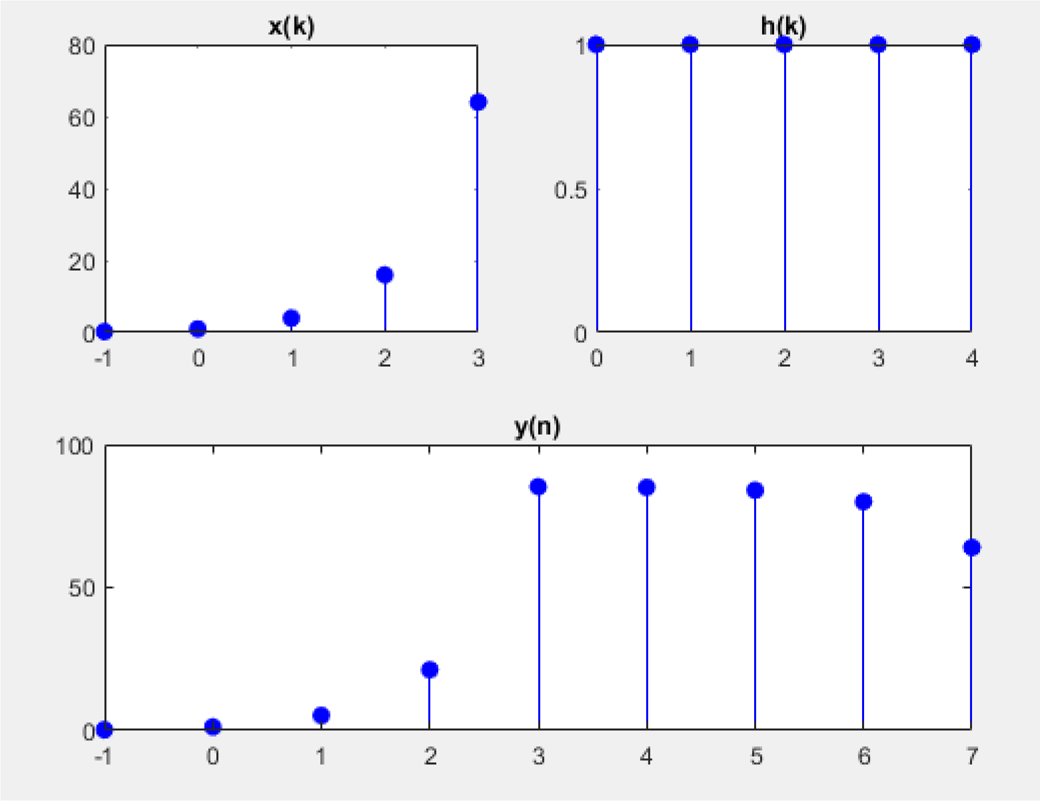
```
x=[2,-4,5,3,-1,-2,6];
xn=[-3,-2,-1,0,1,2,3];
h=[1,-1,1,-1,1];
hn=[-1,0,1,2,3];
xbe=xn(1)+ hn(1);
xye=xn(length(x))+hn(length(h));
n=[xbe:xye];
y=zeros(1,length(n));

for i=1:length(n)
[h1,hn1]=sigfold(h,hn);
[h2,n2]=sigshift(h1,hn1,n(i));
[a,b]=sigmult(x,xn,h2,n2);
y(i)=sum(a);
end

subplot(2,2,1);
stem(xn,x,'b','filled');
xticks([xn]);
title('x(n)');

subplot(2,2,2);
stem(hn,h,'b','filled');
xticks([hn]);
title('h(n)');

subplot(2,2,[3,4]);
stem(n,y,'r','filled');
xticks([n]);
title('y(n)');
```


x(n)
h(n)
y(n)

2. $x(n) = (1/4)^{-n}[u(n+1) - u(n-4)]$, $h(n) = u(n) - u(n-5)$



```
x=[0.25,1,4,16,64];%after finding the points manually
nx=[-1,0,1,2,3];
h=[1,1,1,1,1];
hn=[0,1,2,3,4];
nyb=nx(1)+hn(1);
nye=nx(length(x))+hn(length(h));
ny=[nyb:nye];
y=zeros(1,length(ny));
j=1;
for i=1:length(ny)
    close all;
    [hf , hnf]=sigfold(h,hn);
    [shf,shnf]=sigshift(hf,hnf,ny(i));
    [xnew,nm]=sigmult(x,nx,shf,shnf);
    y(j)=sum(xnew);
    j=j+1;
end
subplot(2,2,1);
stem(nx,x,'b','filled');xticks([nx]); title('x(k)');
subplot(2,2,2);
stem(hn,h,'b','filled');xticks([hn]); title('h(k)');
subplot(2,2,[3,4]);
stem(ny,y,'b','filled');xticks([ny]); title('y(n)');
```



3. $x(n) = n/4[u(n) - u(n-6)]$, $h(n) = 2[u(n+2) - u(n-3)]$

3. $x(n) = \frac{n}{4}\left(u(n) - u(n-6)\right)$

$$x(n) = \begin{cases} n/4 & 0 \le n < 6 \\ 0 & \text{else} \end{cases}$$

$h(n) = 2\left(u(n+2) - u(n-3)\right)$

$$h(k) = \begin{cases} 2 & -2 \le n < 3 \\ 0 & \text{else} \end{cases}$$

$$y(0) = \sum_{k=-\infty}^{\infty} x(k)\, h(0-k)$$

$$h(-k) = \begin{cases} 2 & -3 < n \le 2 \\ 0 & \text{else} \end{cases}$$

$$h(1-k) = \begin{cases} 2 & -2 < n \le 3 \\ 0 & \text{else} \end{cases}$$

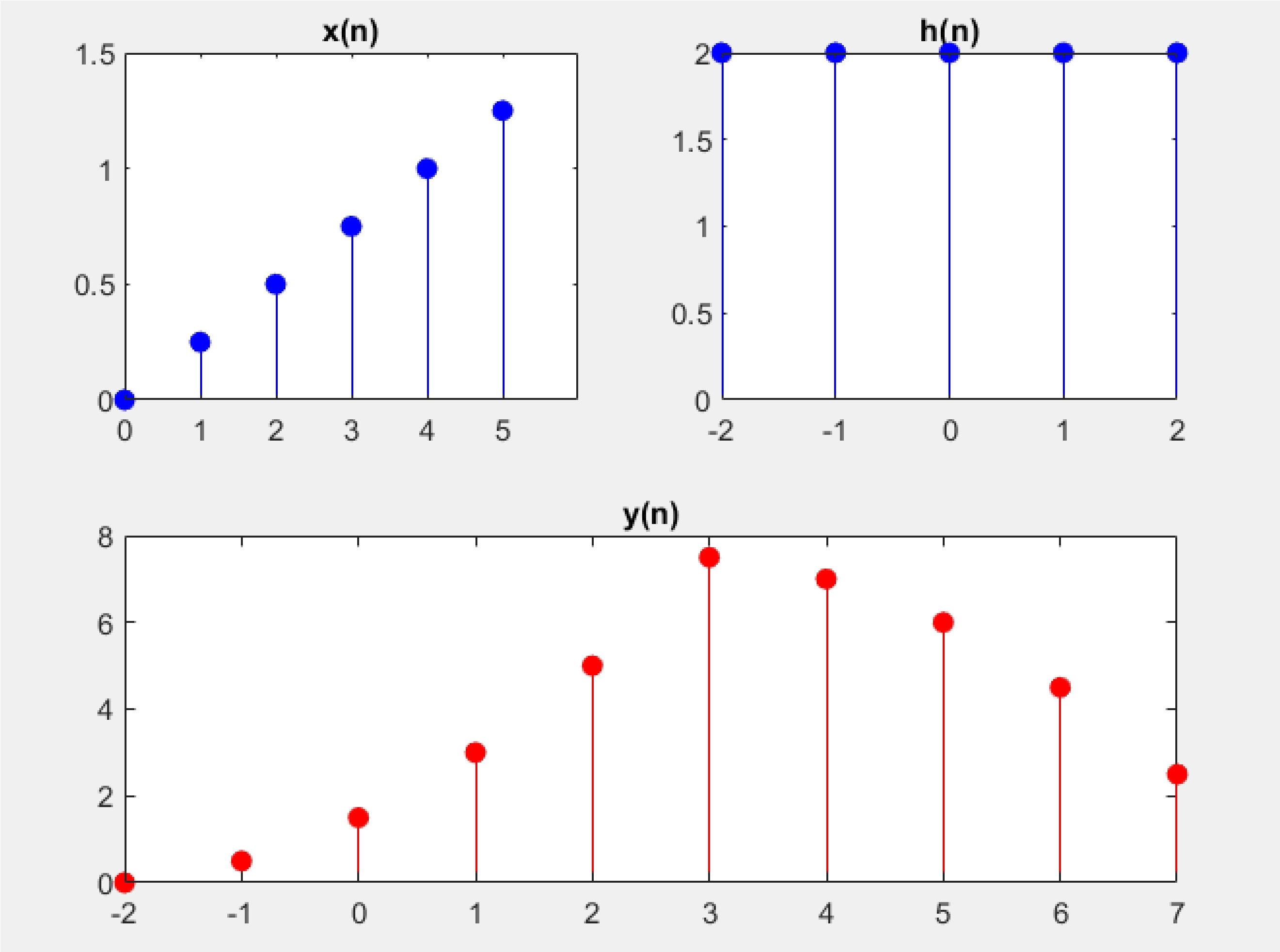
$$h(-1-k) = \begin{cases} 2 & -4 < n \le 1 \\ 0 & \text{else} \end{cases}$$

$y(0) = 0/4 \times 2 + 1/4 \times 2 + 2/4 \times 2$
$= 1/2 + 1 = 1.5$

$y(1) = 0/4 \times 2 + 1/4 \times 2 + 2/4 \times 2 + 3/4 \times 2$
$= 0.5 + 1 + 1.5 = 3$

$y(-1) = 0/4 \times 2 + 1/4 \times 2 = 0.5$

```
x=[0,0.25,0.5,0.75,1,1.25];
xn=[0,1,2,3,4,5];
h=[2,2,2,2,2];
hn=[-2,-1,0,1,2];
xbe=xn(1)+ hn(1);
xye=xn(length(x))+hn(length(h));
n=[xbe:xye];
y=zeros(1,length(n));

for i=1:length(n)
[h1,hn1]=sigfold(h,hn);
[h2,n2]=sigshift(h1,hn1,n(i));
[a,b]=sigmult(x,xn,h2,n2);
y(i)=sum(a);
end

subplot(2,2,1);
stem(xn,x,'b','filled');
xticks([xn]);
title('x(n)');

subplot(2,2,2);
stem(hn,h,'b','filled');
xticks([hn]);
title('h(n)');

subplot(2,2,[3,4]);
stem(n,y,'r','filled');
xticks([n]);
title('y(n)');
```


x(n)
1.5
1
0.5
0
0
1
2
3
4
5
h(n)
2
1.5
1
0.5
0
-2
-1
0
1
2
y(n)
8
6
4
2
0
-2
-1
0
1
2
3
4
5
6
7