Signals & Systems Laboratory

CSE- 301L

Lab # 07

OBJECTIVES OF THE LAB

This lab aims at the understanding of:

Generating unit impulse and unit step sequences

Basic signal operations

7.1 GENERATING UNIT IMPULSE AND UNIT STEP SEQUENCES

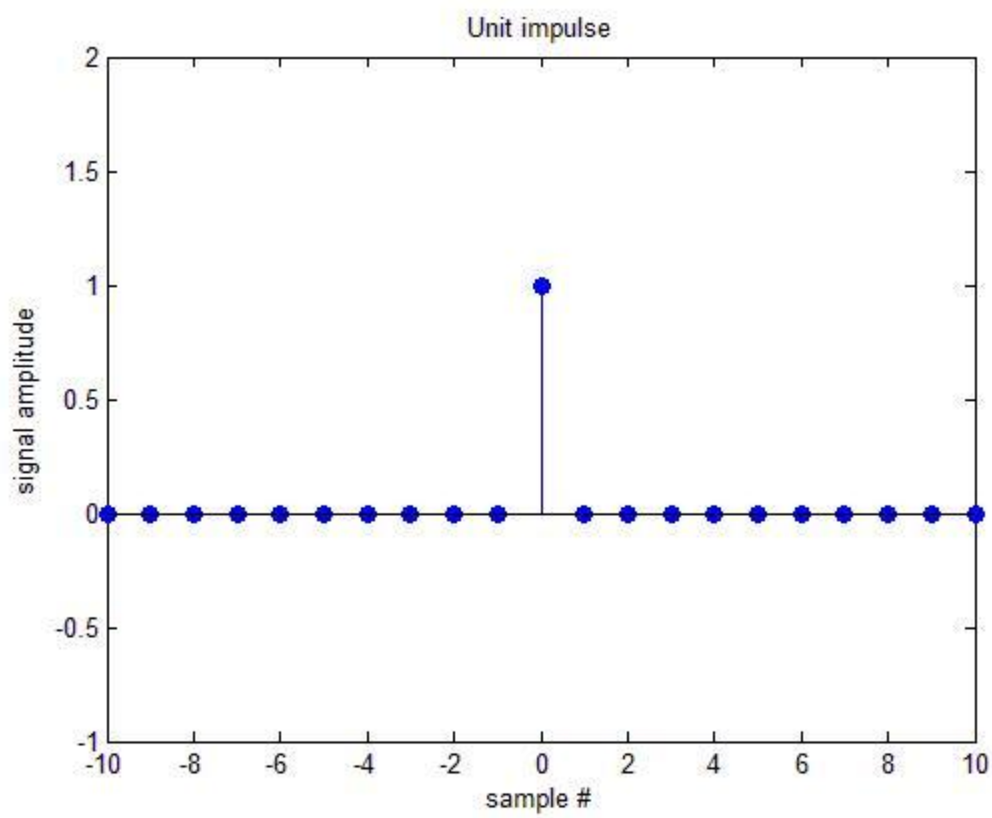
Use matlab commands zeros and ones to generate unit impulse and unit step sequences.

Example: Unit Impulse Sequence

```
n=-10:10;

% unit impulse
x1=[zeros(1,10) 1 zeros(1,10)];

stem(n,x1,'filled');
xlabel('sample #');
ylabel('signal amplitude');
title('Unit impulse');
axis([-10 10 -1 2]);
```

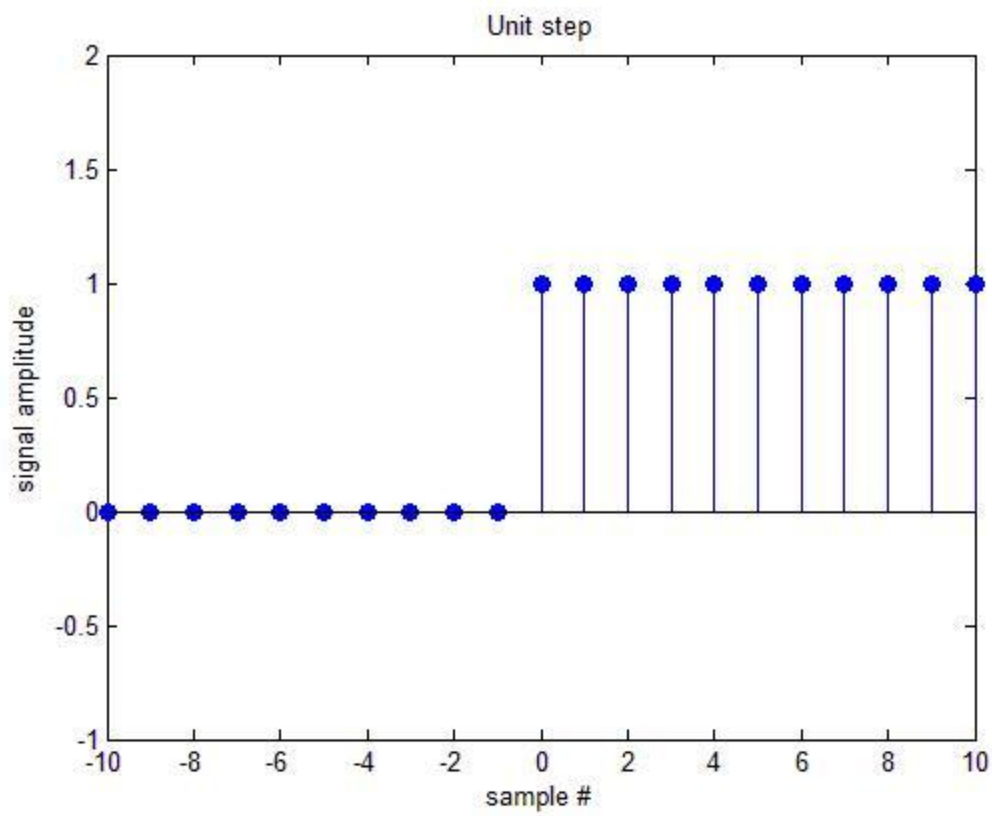


Example: Unit Step Sequence

```
n= -10:10;

%unit step
x1=[zeros(1,10) ones(1,11)];

stem(n,x1,'filled');
xlabel('sample #');
ylabel('signal amplitude');
title('Unit step'); axis([-10
10 -1 2]);
```



----------------------------TASK 1-------------------------

Using **ones** function; plot the **signum** sequence over interval -10≤n≤10. It can be defined as:

$$sign(n) = \begin{cases} 1, & for\ n > 0 \\ -1, & for\ n < 0 \\ 0, & for\ n = 0 \end{cases}$$

-----------------------------Task 2-------------------------

Prove the following:

$$\delta[n] = u[n] - u[n-1]$$

7.2 BASIC SIGNAL OPERATIONS

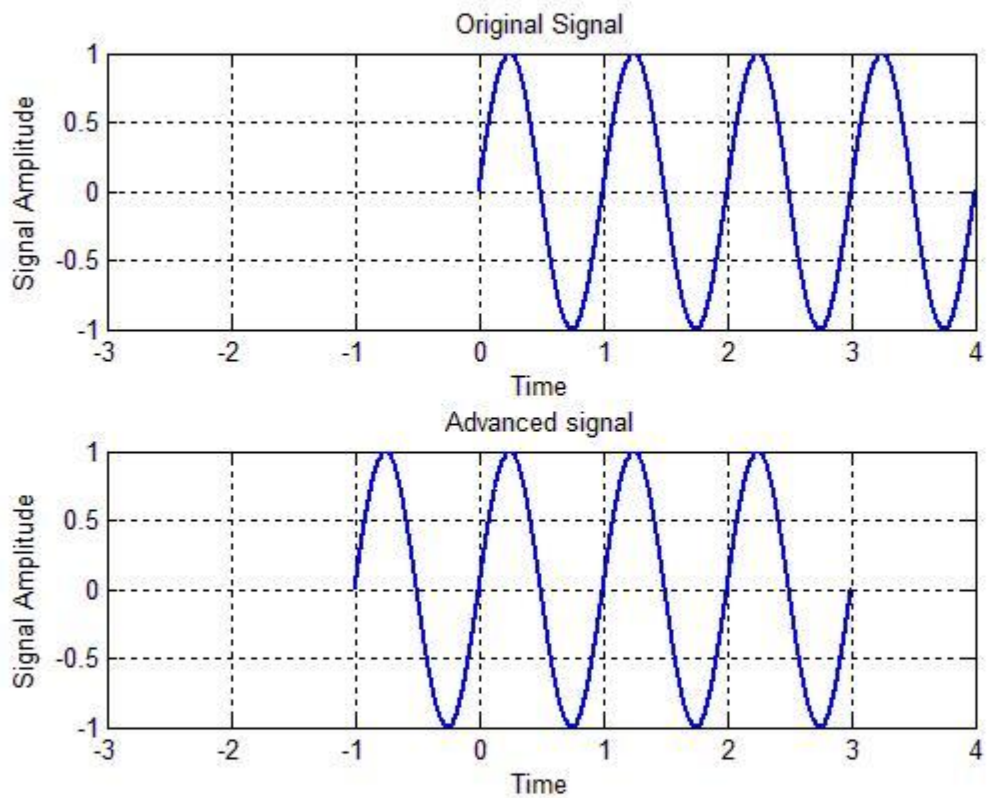
1) Signal Shifting

```
clc
clear all
close all
n=0:0.002:4;
x=sin(2*pi*1*n);

subplot(2,1,1);
plot(n,x,'linewidth',2);
title('Original Signal');
xlabel('Time');
ylabel('Signal Amplitude');
axis([-3 4 -1 1]);
grid;

subplot(2,1,2);
plot(n-1,x,'linewidth',2);
title('Advanced signal');
xlabel('Time');
ylabel('Signal Amplitude');
```

```
axis([-3 4 -1 1]);
grid;
```



-------------------------------Task 3--------------------------

Delay the **original signal** given in above example by 1 sec. Plot both the delayed & original signal on the same figure.

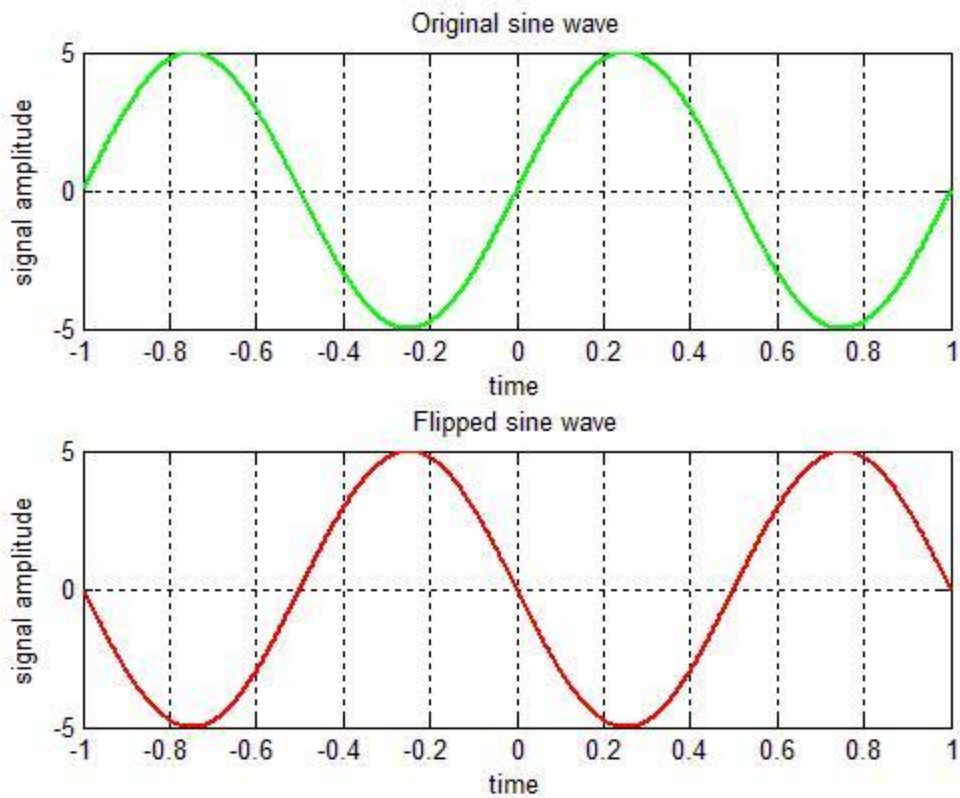
2) Signal Flipping

```
clear n=-1:1/1000:1;
x1=5*sin(2*pi*1*n);

subplot(2,1,1);
plot(n,x1, 'g', 'linewidth',2);
axis([-1 1 -5 5]);
xlabel('time'); ylabel('signal
amplitude');
```

```
title('Original sine wave');
grid;

subplot(2,1,2);
plot(-n,x1, 'r', 'linewidth',2);
axis([-1 1 -5 5]);
xlabel('time'); ylabel('signal
amplitude'); title('Flipped
sine wave'); grid;
```



------------------------------Task 4--------------------------

Flip the following signal:

$$y = 5\ \exp\left(i * n * \frac{\pi}{4}\right)$$

Plot the original signal as well as the flipped one in the same figure.

-----------------------------Task 5-------------------------

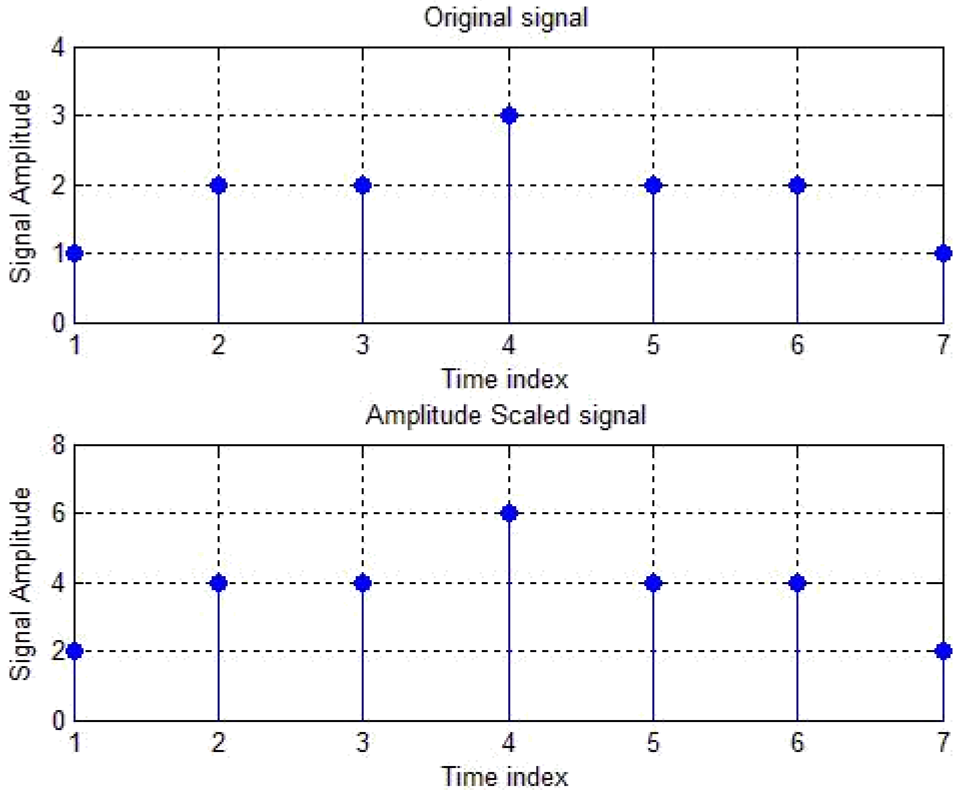
Flip the following signal:

$$x[n]= 2\delta[n]+ 5\delta[n-1] + 8\delta[n-2] + 4\delta[n-3] + 3\delta[n-4]$$

Plot the original signal as well as the flipped one in the same figure.

3) Amplitude Scaling

```
clear
n=1:7;
 x=[1 2 2 3 2 2 1];
subplot(2,1,1);
stem(n,x, 'filled');
title('Original signal');
xlabel('Time index');
ylabel('Signal Amplitude');
axis([1 7 0 4]);
grid;
S=2;
subplot(2,1,2);
stem(n,S*x, 'filled');
title('Amplitude Scaled
signal'); xlabel('Time index');
ylabel('Signal Amplitude');
axis([1 7 0 8]);
grid;
```



-----------------------------Task 6------------------------

Scale the continuous-time sinusoid used in signal shifting example by a factor of 2.

4) Time Scaling

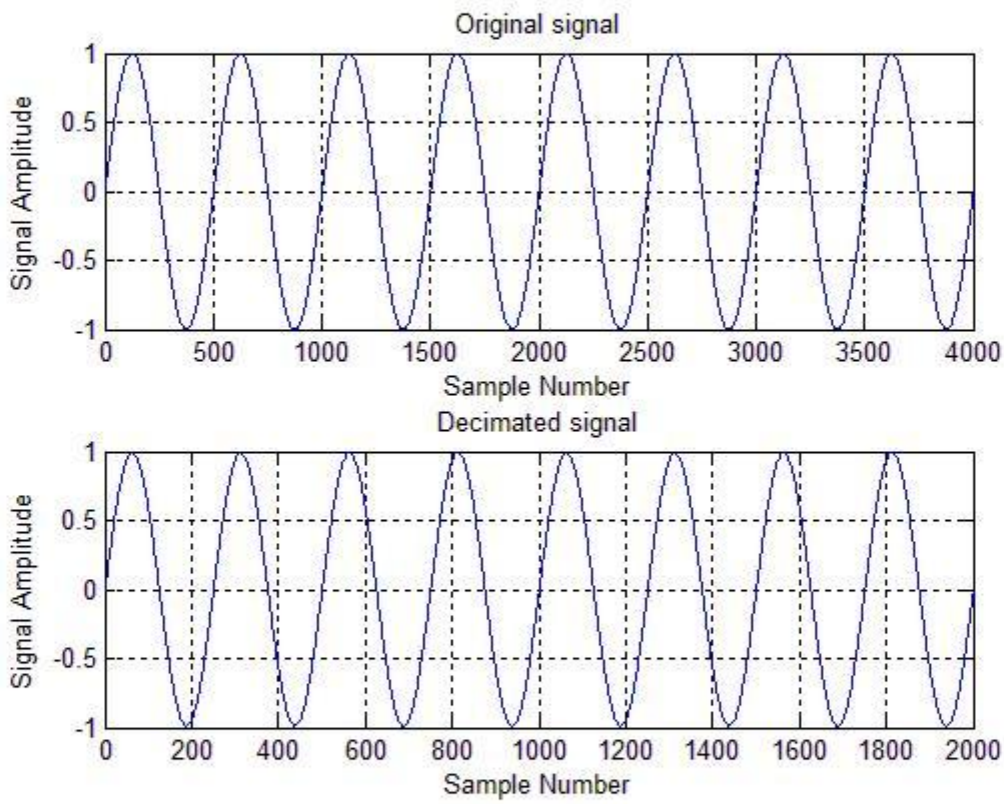
```
%Decimation(down-sampling)
clear

n=-2:1/1000:2;
x1=sin(2*pi*2*n);
x2=decimate(x1,2);

subplot(2,1,1);
plot(x1); title('Original
signal');
xlabel('Sample Number');
ylabel('Signal Amplitude');
```

```
axis([0 4000 -1
1]); grid;

subplot(2,1,2);
plot(x2); title('Decimated
signal'); xlabel('Sample
Number');
ylabel('Signal Amplitude');
axis([0 2000 -1 1]);
grid;
```



-----------------------------Task 7-------------------------

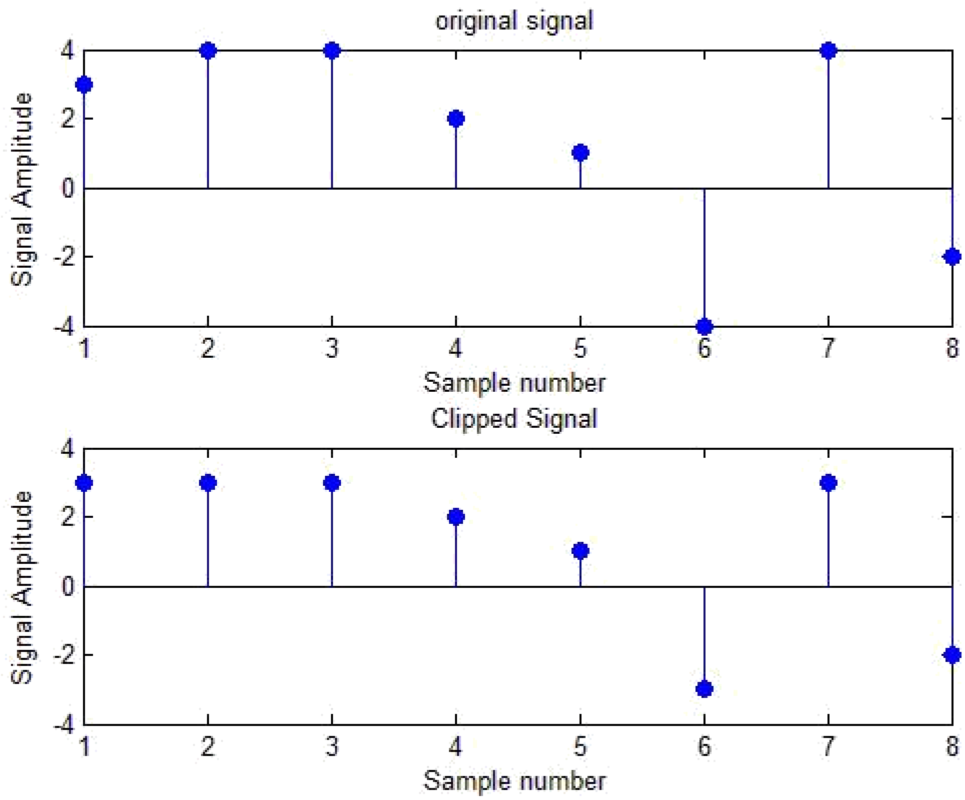
Use ***interp*** command in the above program to interpolate (up-sample) the signal by a factor of 2.

5) Amplitude Clipping

```
clear
x=[3 4 4 2 1 -4 4 -2];
len=length(x);
y=x;
hi=3;
lo=-3;
for i=1:len
        if(y(i)>hi)
                y(i)=hi;
        elseif(y(i)<lo)
                y(i)=lo;
        end
end

subplot(2,1,1);
stem(x,'filled');
title('original signal');
xlabel('Sample number');
ylabel('Signal Amplitude');

subplot(2,1,2);
stem(y,'filled');
title('Clipped Signal');
xlabel('Sample number');
ylabel('Signal Amplitude');
```



6) Signal Replication

```
clear
x=[1 2 3 2 1];
y=[x x x x];
subplot(2,1,1);
stem(x,'filled');
title('Original Signal');
xlabel('Sample Number');
ylabel('Signal Amplitude');
axis([1 20 0 3]);
grid;

subplot(2,1,2);
stem(y,'filled');
title('Replicated Signal');
```

```
xlabel('Sample Number'); ylabel('Signal Amplitude'); axis([1 20 0 3]);
grid;
```