Scilab Manual for Signals and Systems by Dr Dr. R. Anjana Electrical Engineering Laxmi Institute Of Technology, Sarigam, Gujarat[1]

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Experiment: 1

Waveform generation for continuous signals

Scilab code Solution 1.01 PROGRAM TO GENERATE COMMON CONTINUOUS TIME SIGNALS

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3  // CAPTION: PROGRAM TO GENERATE COMMON CONTINUOUS
      TIME SIGNALS
4
5  //UNIT IMPULSE SIGNAL
6  clc;
7  clear all;
8  close;
9  N=5; //SET LIMIT
10 t1=-5:5;
11 x1=[zeros(1,N),ones(1,1),zeros(1,N)];
12 subplot(2,3,1);
13 plot(t1,x1)
14 xlabel('time');
15 ylabel('Amplitude');
```

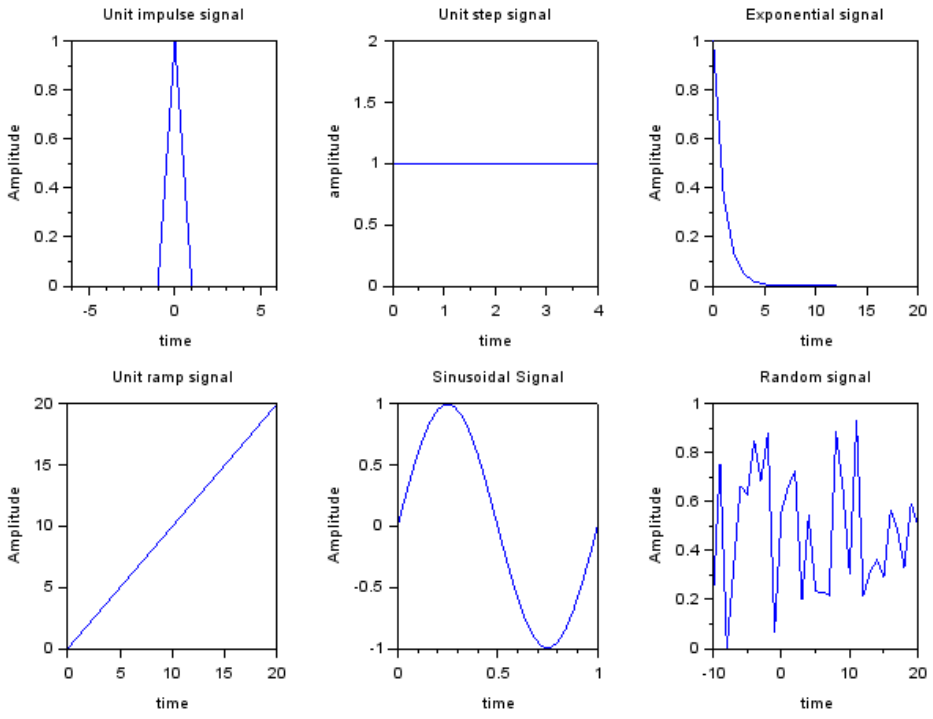

Figure 1.1: PROGRAM TO GENERATE COMMON CONTINUOUS TIME SIGNALS

```
16 title('Unit impulse signal');
17
18
19
20 //UNIT STEP SIGNAL
21 t2=0:4;
22 x2=ones(1,5);
23 subplot(2,3,2);
24 plot(t2,x2);
25 xlabel('time');
26 ylabel('amplitude');
27 title('Unit Step Continuous Signal');
28
29 title('Unit step signal');
30
31 //EXPONENTIAL SIGNAL
32 t3=0:1:20;
33 x3=exp(-t3);
34 subplot(2,3,3);
35 plot(t3,x3);
36 xlabel('time');
37 ylabel('Amplitude');
38 title('Exponential signal');
39
40
41
42 //UNIT RAMP SIGNAL
43 t4=-0:20;
44 x4=t4;
45 subplot(2,3,4);
46 plot(t4,x4);
47 xlabel('time');
48 ylabel('Amplitude');
49 title('Unit ramp signal');
50
51 //SINUSOIDAL SIGNAL
52 t5=0:0.04:1;
53 x5=sin(2*%pi*t5);
```

```
54 subplot(2,3,5);
55 plot(t5,x5);
56 title('Sinusoidal Signal')
57 xlabel('time');
58 ylabel('Amplitude');
59
60 //RANDOM SIGNAL
61 t6=-10:1:20;
62 x6=rand(1,31);
63 subplot(2,3,6);
64 plot(t6,x6);
65 xlabel('time');
66 ylabel('Amplitude');
67 title('Random signal');
```

Experiment: 2

Waveform generation for Discrete signals

Scilab code Solution 2.02 PROGRAM TO GENERATE COMMON DISCRETE TIME SIGNALS

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3  // CAPTION: PROGRAM TO GENERATE COMMON DISCRETE TIME
       SIGNALS
4
5  //UNIT IMPULSE SIGNAL
6  clc;
7  clear all;
8  close;
9  N=5; //SET LIMIT
10 t1=-5:5;
11 x1=[zeros(1,N),ones(1,1),zeros(1,N)];
12 subplot(2,4,1);
13 plot2d3(t1,x1)
14 xlabel('time');
15 ylabel('Amplitude');
```

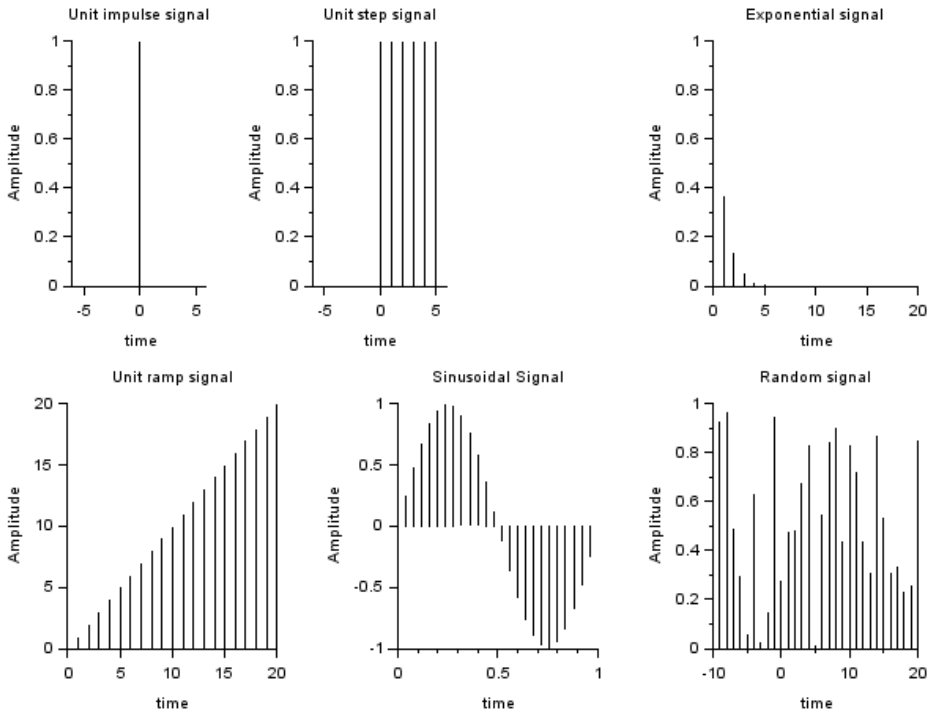

Figure 2.1: PROGRAM TO GENERATE COMMON DISCRETE TIME SIGNALS

```
16 title('Unit impulse signal');
17
18
19 //UNIT STEP SIGNAL
20 t2=-5:5;
21 x2=[zeros(1,N),ones(1,N+1)];
22 subplot(2,4,2);
23 plot2d3(t2,x2)
24 xlabel('time');
25 ylabel('Amplitude');
26 title('Unit step signal');
27
28 //EXPONENTIAL SIGNAL
29 t3=0:1:20;
30 x3=exp(-t3);
31 subplot(2,3,3);
32 plot2d3(t3,x3);
33 xlabel('time');
34 ylabel('Amplitude');
35 title('Exponential signal');
36
37
38
39 //UNIT RAMP SIGNAL
40 t4=0:20;
41 x4=t4;
42 subplot(2,3,4);
43 plot2d3(t4,x4);
44 xlabel('time');
45 ylabel('Amplitude');
46 title('Unit ramp signal');
47
48 //SINUSOIDAL SIGNAL
49 t5=0:0.04:1;
50 x5=sin(2*%pi*t5);
51 subplot(2,3,5);
52 plot2d3(t5,x5);
53 title('Sinusoidal Signal')
```

```
54 xlabel('time');
55 ylabel('Amplitude');
56
57 //RANDOM SIGNAL
58 t6=-10:1:20;
59 x6=rand(1,31);
60 subplot(2,3,6);
61 plot2d3(t6,x6);
62 xlabel('time');
63 ylabel('Amplitude');
64 title('Random signal');
```

Experiment: 3

Basic Operations on DT signals

Scilab code Solution 3.03 TO PERFORM BASIC OPERATIONS ON DT SIGNALS

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION:TO PERFORM BASIC OPERATIONS ON D.T SIGNALS
5
6  clc;
7  clear all;
8  close;
9
10 //amplification
11 x=input('Enter input sequence x:');
12 a=input('Enter amplification factor a:');
13 b=input('Enter attenuation factor b:');
14 c=input('Enter amplitude reversal factor c:');
15 y1=a*x;
16 y2=b*x;
17 y3=c*x;
18 n=length(x);
```

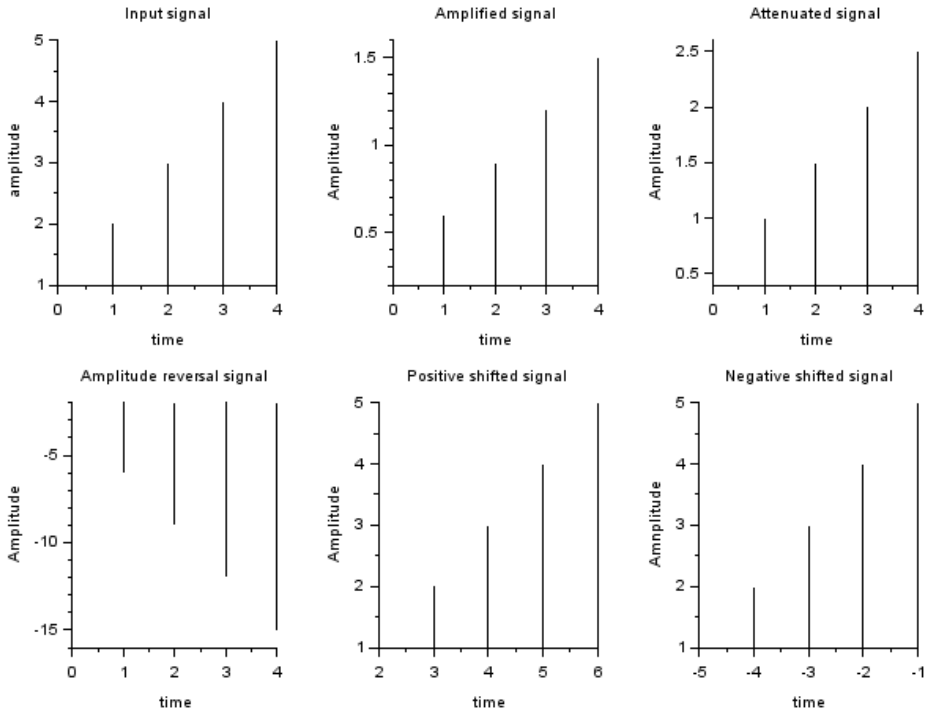

Figure 3.1: TO PERFORM BASIC OPERATIONS ON DT SIGNALS

```
19
20 //Input signal plot
21 subplot(2,3,1);
22 plot2d3(0:n-1,x);
23 xlabel('time');
24 ylabel('amplitude');
25 title('Input signal');
26
27 //Amplification
28 subplot(2,3,2);
29 plot2d3(0:n-1,y1);
30 xlabel('time');
31 ylabel('Amplitude');
32 title('Amplified signal');
33
34 //attenuation
35 subplot(2,3,3);
36 plot2d3(0:n-1,y2);
37 xlabel('time');
38 ylabel('Amplitude');
39 title('Attenuated signal');
40
41 //Amplitude Reverasl
42 subplot(2,3,4);
43 plot2d3(0:n-1,y3);
44 xlabel('time');
45 ylabel('Amplitude');
46 title('Amplitude reversal signal');
47
48 // folding and Shifting
49
50 n0=input('Enter the +ve shift:');
51 n1=input('Enter the -ve shift:');
52 l=length(x);
53 i=n0:l+n0-1;
54 j=n1:l+n1-1;
55 subplot(2,3,5);
56 plot2d3(i,x);
```

```
57 xlabel('time');
58 ylabel('Amplitude');
59 title('Positive shifted signal');
60 subplot(2,3,6);
61 plot2d3(j,x);
62 xlabel('time');
63 ylabel('Amnplitude');
64 title('Negative shifted signal');
65
66
67 //*************************//
68 //INPUT: In Console Window
69 // ************************//
70
71 //Enter the Input Sequence x(n)=[1 2 3 4 5]
72 //Enter the amplification factor a = 0.3
73 //Enter the attenuation factorb = 0.5
74 //Enter the amplitude reversal factor c = -3
75 //Enter the positive shift : 2
76 //Enter the negative shift : -5
77
78  //OUTPUT: In Graphic Windows
```

Experiment: 4

ADDITION AND MULTIPLICATION ON DT SIGNALS

Scilab code Solution 4.04 To perform addition and subtraction of the following two DT signals

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION: To perform addition and subtraction of
       the following two DT signals
5  //Xa(t) =    1; 0<t<1
6  //           2; 1<t<2;
7  //           1; 2<t<3
8
9  // &
10 // Xb(t) = t; 0<t<1
11 //          1; 1<t<2;
12 //         3-t; 2<t<3
13
```

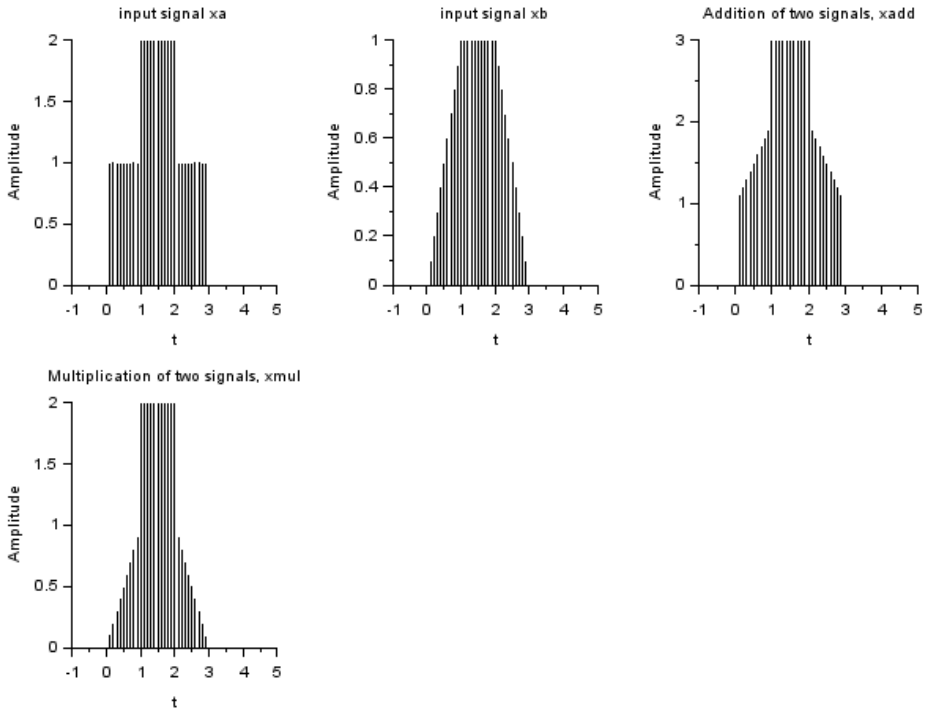

Figure 4.1: To perform addition and subtraction of the following two DT signals

```
14 //
      ////*******************************/////////////////////

15
16 clc;
17 clear all;
18 close
19 t = -1:0.1:5;
20 x1 = 1;
21 x2 = 2;
22 x3 = 3-t;
23
24 xa = x1.*(t>0 & t<1) + x2.*(t>=1 & t<=2) + x1.*(t>2
      & t<3);
25 xb = t.*(t>0 &t<1) + x1*(t>=1 &t<=2)+x3.*(t>2 &t<3);
26
27 xadd = xa +xb;
28 xmul = xa.*xb;
29 subplot(2,3,1);
30 plot2d3(t,xa)  //Plots input signal xa
31 xlabel('t');
32 ylabel('Amplitude');
33 title('input signal xa');
34 subplot(2,3,2);
35 plot2d3(t,xb)  //Plots input signal xb
36 xlabel('t');
37 ylabel('Amplitude');
38 title('input signal xb');
39 subplot(2,3,3);
40 plot2d3(t,xadd)  //Plots addition of signal xa and
      xb
41 xlabel('t');
42 ylabel('Amplitude');
43 title('Addition of two signals, xadd');
44 subplot(2,3,4);
45 plot2d3(t,xmul)  //Plots Multiplication of signal xa
       and xb
46 xlabel('t');
```

```
47 ylabel('Amplitude');
48 title('Multiplication of two signals, xmul');
49
50 //// Output : In Graphic Window
```

Experiment: 5

EVEN and ODD SIGNALS

Scilab code Solution 5.05 EVEN and ODD SIGNALS

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION: EVEN and ODD SIGNALS for x(t)=sint(t)+cos
       (t)
5
6  clc;
7  close;
8  clear all;
9  t=0:.005:4*%pi;
10 x=sin(t)+cos(t); // Given signal: x(t)=sint(t)+cos(t
       )
11 subplot(2,2,1)
12 plot(t,x)
13 xlabel('t');
14 ylabel('amplitude')
15 title('input signal')
16 y=sin(-t)+cos(-t) // Put t = -t in x(t)
17 subplot(2,2,2)
```

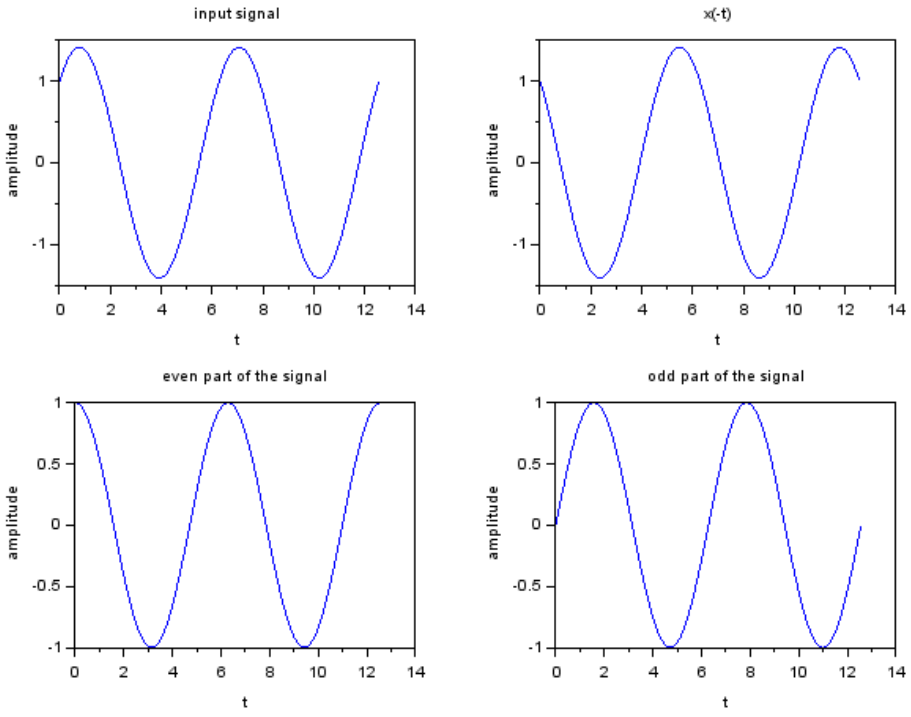

Figure 5.1: EVEN and ODD SIGNALS

```
18 plot(t,y)
19 xlabel('t');
20 ylabel('amplitude')
21 title('x(-t)')
22 z=x+y
23 subplot(2,2,3)
24 plot(t,z/2)  // to plot even signal
25 xlabel('t');
26 ylabel('amplitude')
27 title('even part of the signal')
28 p=x-y
29 subplot(2,2,4)
30 plot(t,p/2) // to plot odds signal
31 xlabel('t');
32 ylabel('amplitude');
33 title('odd part of the signal');
34
35 //Output: In graphic window
```

Experiment: 6

Linear and Non-linear Signals

Scilab code Solution 6.06 To find wheather the system is linear or non linear for the given signal

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION: To find wheather the system is linear or
       non linear for the given signal y(n)=[x(n)]^2+B;
5
6  clc;
7  clear all;
8  close;
9
10 //Properties of DT Systems(Linearity)
11 //y(n)=[x(n)]^2+B;
12
13 x1=input('Enter first input sequence:');
14 n=length(x1);
15 x2=input('Enter second input sequence:');
16 a=input('Enter scaling constant(a):');
17 b=input('Enter scaling constant(b):');
```

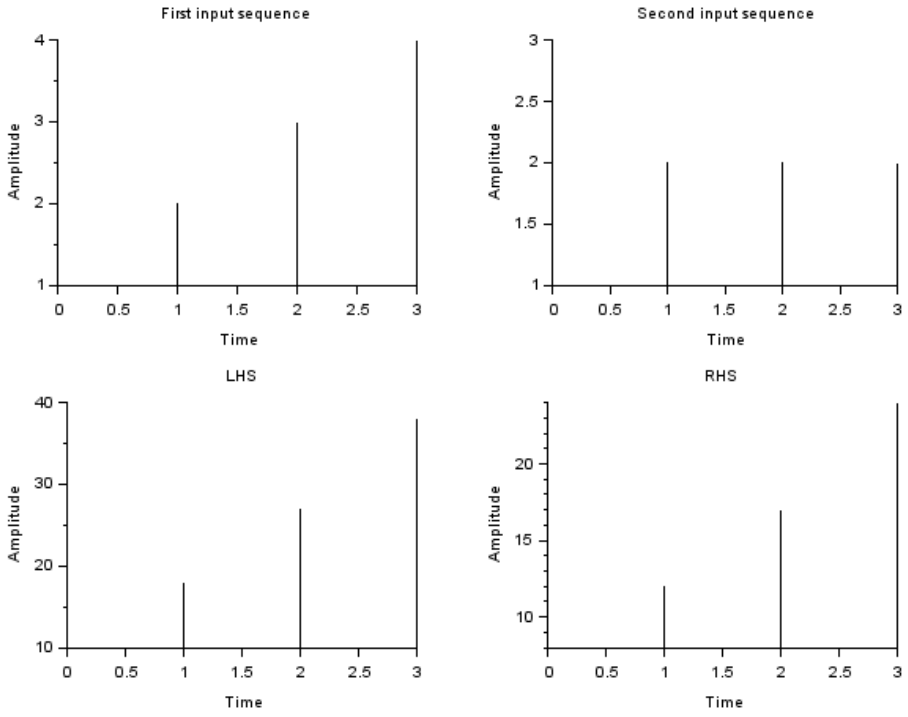

Figure 6.1: To find wheather the system is linear or non linear for the given signal

```
18 B=input('Enter scaling constant(B):');
19
20 y1=x1.^2+B;
21 y2=x2.^2+B;
22 rhs=a*y1+b*y2;
23 x3=a*x1+b*x2;
24 lhs=x3.^2+B;
25
26 subplot(2,2,1);
27 plot2d3(0:n-1,x1);
28 xlabel('Time');
29 ylabel('Amplitude');
30 title('First input sequence');
31 subplot(2,2,2);
32 plot2d3(0:n-1,x2);
33 xlabel('Time');
34 ylabel('Amplitude');
35 title('Second input sequence');
36 subplot(2,2,3);
37 plot2d3(0:n-1,lhs);
38 xlabel('Time');
39 ylabel('Amplitude');
40 title('LHS');
41 subplot(2,2,4);
42 plot2d3(0:n-1,rhs);
43 xlabel('Time');
44 ylabel('Amplitude');
45 title('RHS');
46
47 if(lhs==rhs)
48     disp('system is linear');
49 else
50     disp('system is non-linear');
51
52 end;
53
54
55 //// Input Data
```

```
56
57 //Enter first input sequence:[1 2 3 4]
58 //Enter second input sequence:[ 2 2 2 2 ]
59 //Enter scaling constant(a):1
60 //Enter scaling constant(b):1
61 //Enter scaling constant(B):2
62
63 /// Output:  system is non-linear
64 //See graphic window
```

Experiment: 7

Energy and Power Signal

Scilab code Solution 7.7 To find the energy and power of a signal

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION: To find the energy and power of a signal
5
6
7  //To find energy of a signal
8  clc;
9  clear all;
10 close;
11  E =0;
12  for n =0:50
13  x ( n +1) =( 0.5) ^ n ;
14  end
15  for n =0:100
16  E = E + x (n +1) ^2;
17  end
18  if E < %inf then
19  disp (E ,'The Energy of the given signal is E = ')
       ;
20  else
```

```
21  disp ( 'The given signal is energy signal is not an
        Energy Signal' ) ;
22 end
23
24 ///// To find power of the Signal
25 T=10;          //Total evaluation time
26 Ts=0.001;     //Sampling time =&gt; 1000 samples per
      second
27 Fs=1/Ts;      //Sampling period
28 t=[0:Ts:T]; //define simulation time
29 x=cos(2*%pi*100*t)+cos(2*%pi*200*t)+sin(2*%pi*300*t)
      ;
30 power = (norm(x)^2)/length(x);
31 disp(power, 'The power of the given signal is P = ')
32
33
34 // output
35 //The Energy of the given signal is E =51.333333
36
37 // The power of the given signal is P = 1.50025
```

Experiment: 8

Time Variance and Time Invariance

Scilab code Solution 8.08 To find wheather the signal is time variant or time invariant for the signal

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION: To find wheather the signal is time
       variant or time invariant for the signal y(n)=n*[
       x(n)];
5  clc;
6  clear all;
7  close ;
8   x1=input('Enter input sequence x1:');
9  n1=length(x1);
10 for n=1:n1
11     y1(n1)=n.*x1(n);
12 end;
13 n0=input('Enter shift:');
14 x2=[zeros(1,n0),x1];
```

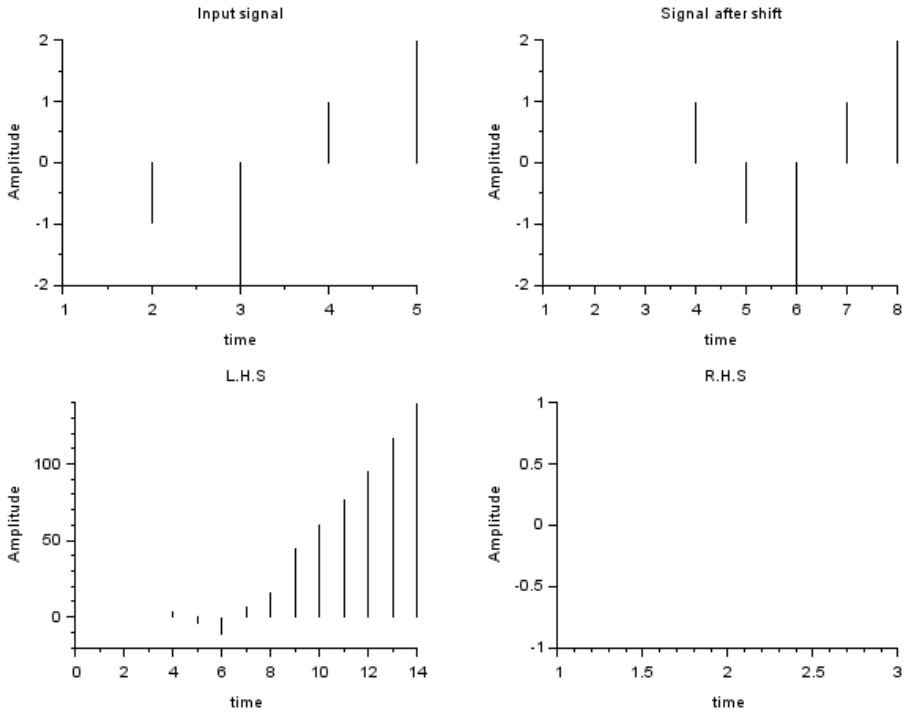

Figure 8.1: To find wheather the signal is time variant or time invariant for the signal

```
for n2=1:n1+n0
    y2(n2)=n2.*x2(n2);
end;
y3=[zeros(1,n0)],y1;
 if(y2==y3)
    disp('system is time invariant');
else
    disp('system is time variant');
end;
subplot(2,2,1);
plot2d3(x1);
xlabel('time');
ylabel('Amplitude');
title('Input signal');
subplot(2,2,2);
plot2d3(x2);
xlabel('time');
ylabel('Amplitude');
title('Signal after shift');
subplot(2,2,3);
plot2d3(y2);
xlabel('time');
ylabel('Amplitude');
title('L.H.S');
subplot(2,2,4);
plot2d3(y3);
xlabel('time');
ylabel('Amplitude');
title('R.H.S');


//// Sample Input
///Enter input sequence x1:[1 -1 -2 1 2]
//Enter shift:3

// Output
//system is time variant
```

Experiment: 9

DISCRETE CONVOLUTION

Scilab code Solution 9.09 To perform discrete convolution for two given sequences

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION: To perform discrete convolution for two
       given sequences
5
6  clc;
7  clear all;
8  close ;
9  a=input('Enter the starting point of x[n]=');
10  b=input('Enter the starting point of h[n]=');
11 x=input('Enter the co-efficients of x[n]=');
12 h=input('Enter the co-efficients of h[n]=');
13 y=conv(x,h);
14 subplot(3,1,1);
15  p=a:(a+length(x)-1);
16 plot2d3(p,x);
17  xlabel('Time');
```

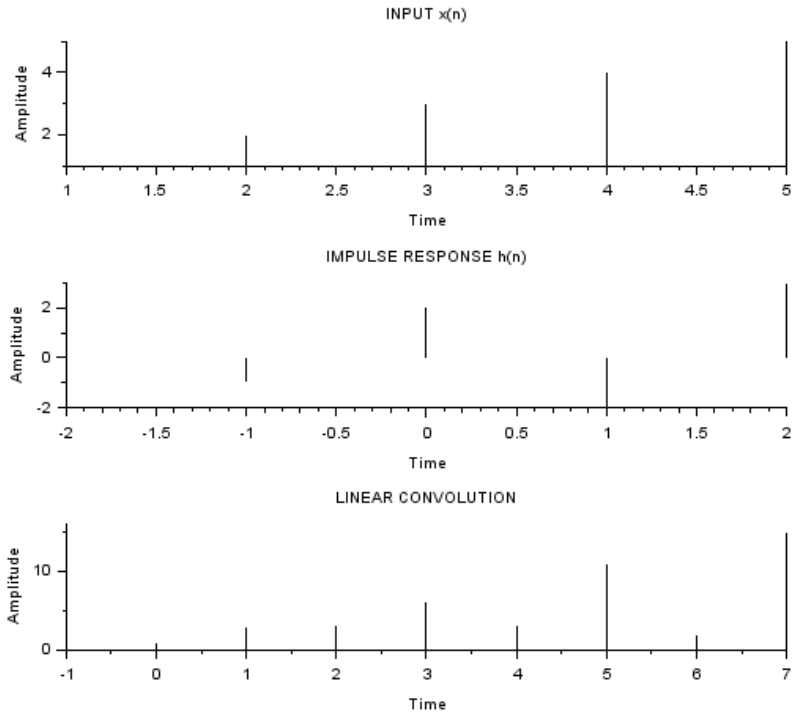

Figure 9.1: To perform discrete convolution for two given sequences

```
18  ylabel('Amplitude');
19  title('INPUT x(n)');
20  subplot(3,1,2);
21   q=b:(b+length(h)-1);
22 plot2d3(q,h);
23  xlabel('Time');
24 ylabel('Amplitude');
25 title('IMPULSE RESPONSE h(n)');
26 subplot(3,1,3);
27  n=a+b:length(y)+a+b-1;
28  plot2d3(n,y);
29
30 disp(y)
31 xlabel('Time');
32 ylabel('Amplitude');
33 title('LINEAR CONVOLUTION');
34
35 ///Sample Input
36 //Enter the starting point of x[n]=1
37 //Enter the starting point of h[n]=-2
38 //Enter the co-efficients of x[n]=[1 2 3 4 5]
39 //Enter the co-efficients of h[n]=[1 -1 2 -2 3]
40
41 // output: See the Graphic window
```

Experiment: 10

Z- TRANSFORMS AND INVERSE Z - TRANFORM

Scilab code Solution 10.10 To find Z Transform and inverse Z Transform for the given sequence

```
1
2 // VERSION: Scilab: 5.4.1
3 // OS: windows 7
4
5 //CAPTION: To find Z-Transform and inverse Z-
     Transform for the given sequence
6
7 // Z transform of given sequence
8 clear all;
9 clc ;
10  close ;
11  z = poly (0 , 'z' , 'r');
12  x1 = input('enter the input sequence:');
13  n1 = 0: length ( x1 ) -1;
14 X1 = x1.*[(1/ z ) .^n1];
15 disp(X1,'the z-transform of X1: ')
16
17
```

```
// Inverse Z-transform


 z=%z;
 a =(2+2* z+z ^2) ;
b=z^2;
 h = ldiv (b,a ,6);
disp (h," The Inverse Z - Transform is");



// Sample input data

//enter the input sequence:[1 2 3 4 5]



// Output Data

//the z-transform of X1:

 //    1      2      3      4      5
 //    -      -      -      -      -
////                      2      3      4
 //    1      z      z      z      z

 // The Inverse Z - Transform is

 //    1.
 // - 2.
 //    2.
 //    0.
//  - 4.
 //    8.
```

Experiment: 11

Fourier Transform

Scilab code Solution 11.11 Fourier Transform

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION:A symmetrical rectangular pulse is given
       by R(n) = 1 ; -N<n<N  = 0 ; otherwise;
5  //Determine The DTFT for N = {5,15,25,100}. Scale
       the DTFT so that x(0) = 1 ,also plot the
       normalized DTFT over -   to   .
6
7
8  clc;
9  clear all;
10 close
11 N=input('Enter The Value Of N1 = ');
12 n=-N:1:N;
13 x=ones(1,length(n));
14 w=(-%pi:(%pi/100):%pi);
15 z=x*exp(-%i*n'*w);
16 subplot(2,2,1);
```

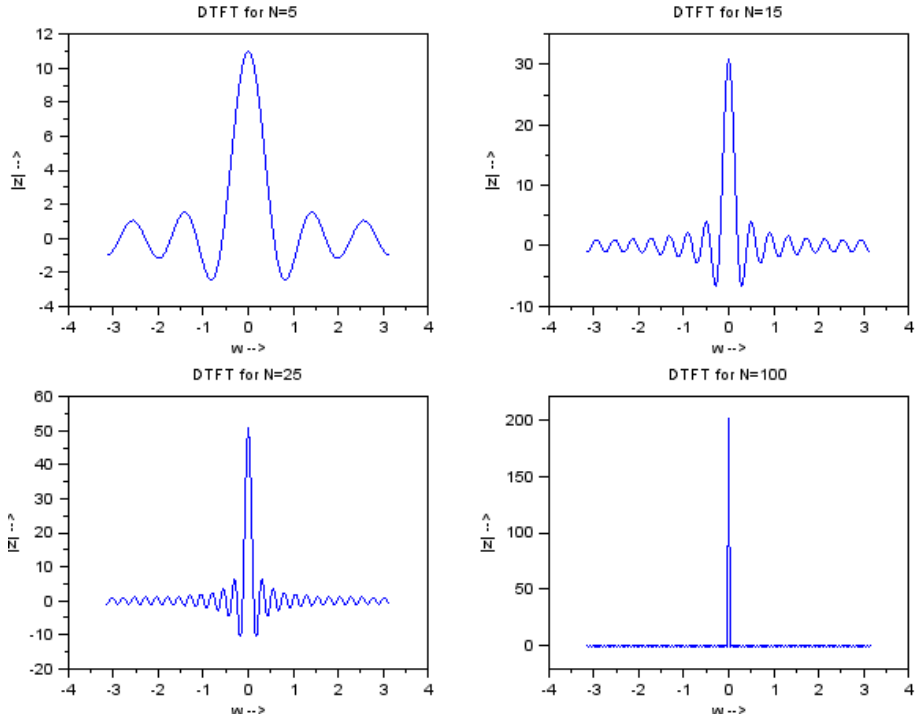

Figure 11.1: Fourier Transform

```
17 plot(w,z);
18 xlabel('w -->');
19 ylabel('|z| -->');
20 title('DTFT for N=5');
21
22 N=input('Enter The Value Of N2 = ');
23 n=-N:1:N;
24 x=ones(1,length(n));
25 w=(-%pi:(%pi/100):%pi);
26 z=x*exp(-%i*n'*w);
27 subplot(2,2,2);
28 plot(w,z);
29 xlabel('w -->');
30 ylabel('|z| -->');
31 title('DTFT for N=15');
32
33 N=input('Enter The Value Of N3 = ');
34 n=-N:1:N;
35 x=ones(1,length(n));
36 w=(-%pi:(%pi/100):%pi);
37 z=x*exp(-%i*n'*w);
38 subplot(2,2,3);
39 plot(w,z);
40 xlabel('w -->');
41 ylabel('|z| -->');
42 title('DTFT for N=25');
43
44 N=input('Enter The Value Of N4 = ');
45 n=-N:1:N;
46 x=ones(1,length(n));
47 w=(-%pi:(%pi/100):%pi);
48 z=x*exp(-%i*n'*w);
49 subplot(2,2,4);
50 plot(w,z);
51 xlabel('w -->');
52 ylabel('|z| -->');
53 title('DTFT for N=100');
54
```

```
55 ////////////////////////
56 /// SAMPLE INPUTS//////
57
58 //Enter The Value Of N1 = 5
59 //Enter The Value Of N2 = 15
60 //Enter The Value Of N3 = 25
61 //Enter The Value Of N4 = 100
```

Experiment: 12

Fourier Series

Scilab code Solution 12.12 Write a program to find the fourier series coefficients of a signal

```
1
2 // VERSION: Scilab: 5.4.1
3 // OS: windows 7
4
5 //CAPTION: Write a program to find the fourier
     series coefficients of a signal.
6
7 fig_size = [232 84 774 624];
8 x = [0.1 0.9 0.1];// % 1 period of x(t)
9 x = [x x x x]; //% 4 periods of x(t)
10 tx = [-2 -1 0 0 1 2 2 3 4 4 5 6]; //% time points
     for x(t)
11 subplot(2,2,1)
12 plot(tx,x)
13 xlabel('Time (s)')
14 ylabel('Amplitude'),...
15 title('Periodic Signal x(t)')
16
```

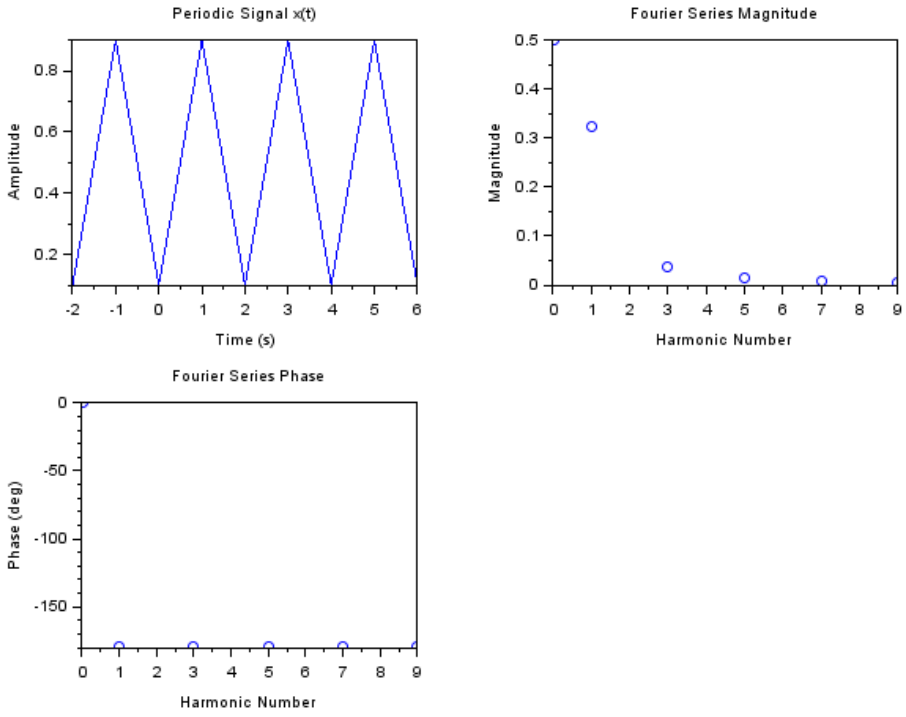

Figure 12.1: Write a program to find the fourier series coefficients of a signal

```
17 a0 = 0.5; // DC component of Fourier Series
18 ph0 = 0;
19 n = [1 3 5 7 9];// Values of n to be evaluated
20 an = -3.2 ./ (%pi * n).^2; //% Fourier Series
      coefficients
21 mag_an = abs(an);
22 ph_an = -180 * ones(1,length(n));
23 n = [0 n];
24 mag_an = [a0 mag_an];// % Including a0 with a_n
25 ph_an = [ph0 ph_an];
26
27 //Plotting fourier series magnitude
28 subplot(2,2,2)
29 plot(n,mag_an,'o');
30 xlabel('Harmonic Number');
31 ylabel('Magnitude');
32 title('Fourier Series Magnitude')
33
34 //Plotting fourier series phase
35 subplot(2,2,3)
36 plot(n,ph_an,'o')
37 xlabel('Harmonic Number')
38 ylabel('Phase (deg)')
39 title('Fourier Series Phase'),
```

Experiment: 13

Causal and Non-Causal

Scilab code Solution 13.13 To find whether the system is causal or non causal

```
1
2 // VERSION: Scilab: 5.4.1
3 // OS: windows 7
4
5 //CAPTION: To find whether the system is causal or
     non-causal
6
7 clc;
8 clear all;
9 close;
10 // %Properties of DT Systems(Causality)
11 //%y(n)=x(-n);
12
13 x1=input('Enter input sequence x1:');
14 n1=input('Enter upper limit n1:');
15 n2=input('Enter lower limit n2:');
16 flag=0;
17 for n=n1:n2
18   arg=-n;
19   if arg>n;
```

```
20          flag=1;
21  end;
22  end;
23   if(flag==1)
24      disp('system is causal');
25  else
26      disp('system is non-causal');
27      end
28
29  /// Sample inputs
30  //Enter input sequence x1:[1 2 -1 3 -4 5 -5]
31  //Enter upper limit n1:2
32  //Enter lower limit n2:-2
33
34  // output :
35  //system is non-causal
```

Experiment: 14

Sampling Theorem

Scilab code Solution 14.14 To find the sampling theoram

```
1
2 // VERSION: Scilab: 5.4.1
3 // OS: windows 7
4
5 //CAPTION: To find the sampling theoram
6
7 clc;
8 T=0.04;
9 t=0:0.0005:0.02;
10 f = 1/T;
11 n1=0:40;
12 size(n1)
13 xa_t=sin(2*%pi*2*t/T);
14 subplot(2,2,1);
15 plot2d3(200*t,xa_t);
16 title('Verification of sampling theorem');
17 title('Continuous signal');
18 xlabel('t');
19 ylabel('x(t)');
```

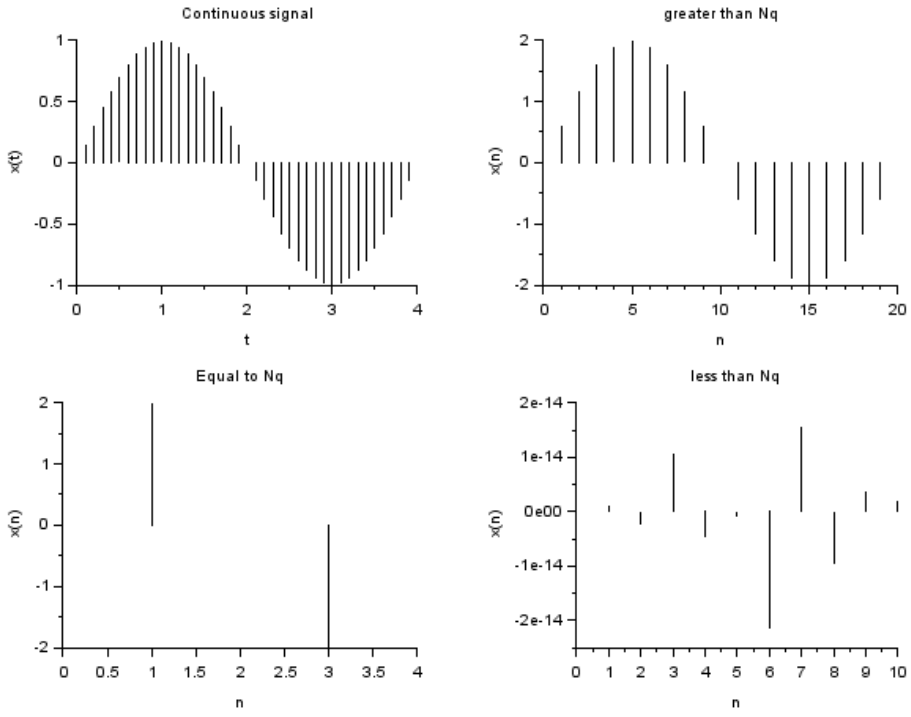

Figure 14.1: To find the sampling theoram

```
20
21 //greater than nyquist rate
22 ts1=0.002;//>niq rate
23 n=0:20;
24 x_ts1=2*sin(2*%pi*n*ts1/T);
25 subplot(2,2,2);
26 plot2d3(n,x_ts1);
27 title('greater than Nq');
28 xlabel('n');
29 ylabel('x(n)');
30
31 //Equal to nyquist rate
32
33 ts2=0.01;//niq rate
34 n=0:4;
35 x_ts2=2*sin(2*%pi*n*ts2/T);
36 subplot(2,2,3);
37 plot2d3(n,x_ts2);
38 title('Equal to Nq');
39 xlabel('n');
40 ylabel('x(n)');
41
42 //less than nyquist rate
43 ts3=0.1;//<niq rate
44 n=0:10;
45 x_ts3=2*sin(2*%pi*n*ts3/T);
46 subplot(2,2,4);
47 plot2d3(n,x_ts3);
48 title('less than Nq');
49 xlabel('n');
50 ylabel('x(n)');
```

Experiment: 15

Sampling rate Conversion

Scilab code Solution 15.15 Sampling Rate Conversion

```
1  // VERSION: Scilab: 5.4.1
2  // OS: windows 7
3
4  //CAPTION: Sampling Rate Conversion
5
6  //Down Sampling (or Decimation):
7
8  xn = input(' Enter the number of samples xn:');[1 2
       3 4 5 6 8 ]
9  N=length(xn);
10 n=0:1:N-1;
11 D=3;
12 xDn=xn(1:D:N);
13 n1=1:1:N/D;
14 //figure;
15 disp(xDn,'the downsampling (or) Decimation for D = 3
       is:------>')
16
17 //Up Sampling (or Interpolation)
18 yn = input(' Enter the number of samples yn:')///[1
       -2 3 4 8 9 10 44]
```

```
19 N=length(yn)
20 n=0:1:N-1
21 I=2
22 xIn=[zeros(1,I*N)]
23 n1=1:1:N*I
24 j=1:I:I*N
25 xIn(j)=yn
26 disp(xIn, 'The upsampling (or) interpolation for I =
       2 is:------>')
27
28
29 ///Sample Input
30
31 // Enter the number of samples xn:[1 2 3 4 5 6 8 ]
32 //Enter the number of samples yn:[1 -2 3 4 8 9 10
      44]
33
34
35 // Output Data
36 ////////**********////////
37
38 //the downsampling (or) Decimation for D = 3 is
      :------>
39
40 //1.    4.    8.
41
42 ////////**********////////
43
44 ///The upsampling (or) interpolation for I = 2 is
      :------>
45
46 //column 1 to 9
47
48  //   1.    0.  - 2.    0.    3.    0.    4.    0.
         8.
49
50  //        column 10 to 16
51
```

```
52  //    0.    9.    0.    10.    0.    44.    0.
```