Scilab Manual for Signal Processing by Mrs S. Chaya Electronics Engineering AIKTC [1]

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Contents

List of Scilab Solutions 3

1 Image Sampling and Quantization 6

2 Understanding basic relationship between pixel 13

3 Program for Image sharpening. 22

4 Program for lossless Image Compression. 30

5 Program for lossy Image Compression. 32

6 Program for generation and Manipulation of signal. 38

7 Program for Discrete Fourier Transform 50

8 Simulation of FIR Filters 54

9 Generation and Quantization of Binary Numbers 57

10 Introduction to Simulink Signal Analysis 60

11 Design and analysis of Butterworth Filter 63

12 Impulse response of first order and second order system 67

13 Circular convolution of two given sequences. 70

14 Linear convolution of two given sequences. 73

List of Experiments

Solution 1.1	Exp1a	6
Solution 1.2	Exp1b	8
Solution 2.1	Exp2a	13
Solution 2.2	Exp2b	14
Solution 3.1	Exp3a	22
Solution 3.2	Exp3b	23
Solution 4.1	Exp4	30
Solution 5.1	Exp5	32
Solution 6.1	Exp6a	38
Solution 6.2	Exp6b	41
Solution 6.3	Exp6c	44
Solution 6.4	Exp6d	47
Solution 7.1	Exp7	50
Solution 8.1	Exp8	54
Solution 9.1	Exp9	57
Solution 10.1	Exp10a	60
Solution 10.2	Exp10b	60
Solution 11.1	Exp11	63
Solution 12.1	Exp12	67
Solution 13.1	Exp13	70
Solution 14.1	Exp14	73
AP 1	Cameraman Image file	76
AP 2	Rice Image File	77
AP 3	Hestian Colour Image File	78
AP 4	Lenna Image File	79

List of Figures

1.1 Exp1a 7
1.2 Exp1a 9
1.3 Exp1b 10
1.4 Exp1b 12

2.1 Exp2a 15
2.2 Exp2a 16
2.3 Exp2b 20
2.4 Exp2b 21

3.1 Exp3a 24
3.2 Exp3a 25
3.3 Exp3b 27
3.4 Exp3b 28

4.1 Exp4 30

5.1 Exp5 36
5.2 Exp5 37

6.1 Exp6a 41
6.2 Exp6a 42
6.3 Exp6b 43
6.4 Exp6c 45
6.5 Exp6d 48

7.1 Exp7 51

8.1 Exp8 55

9.1 Exp9 58

10.1 Exp10a 61
10.2 Exp10b 61

11.1 Exp11 64

12.1 Exp12 68

13.1 Exp13 71

Experiment: 1

Image Sampling and Quantization

check Appendix AP 1 for dependency:

cameraman.jpeg

Scilab code Solution 1.1 Exp1a

```
1  //Image Quantization
2  clear;
3  clc;
4  I = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\cameraman.jpeg');
5  quanta = 50;
6  J = double(I)/255;
7  J = uint8(J*quanta);
8  J = double(J)/quanta;
9  figure
10 ShowImage(I,'Original Image')
11 figure
12 ShowImage(J,'Quantized Image')
```

Figure 1.1: Exp1a

check Appendix AP 1 for dependency:

`cameraman.jpeg`

Scilab code Solution 1.2 Exp1b

```
1  //Image Sampling
2  clear;
3  clc;
4  I = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\cameraman.jpeg');
5  J = imresize(I,0.5); //Reducing the sampling rate
6  K1 = imresize(J,2,'nearest'); //Increasing the
       sampling rate
7  K2 = imresize(J,2,'bilinear');
8  K3 = imresize(J,2,'bicubic');
9  figure
10 ShowImage(I,'Original Image')
11 figure
12 ShowImage(J,'Reducing the Sampling Rate by 2')
13 figure
14 ShowImage(K1,'Increasing the Sampling Rate by 2
       nearest neighbour method')
15 figure
16 ShowImage(K2,'Increasing the Sampling Rate by 2
       bilinear method')
17 figure
18 ShowImage(K3,'Increasing the Sampling Rate by 2
       bicubic method')
```

Figure 1.2: Exp1a

Figure 1.3: Exp1b

Figure 1.4: Exp1b

Experiment: 2

Understanding basic relationship between pixel

check Appendix AP 1 for dependency:

`cameraman.jpeg`

check Appendix AP 2 for dependency:

`rice.jpg`

Scilab code Solution 2.1 Exp2a

```
1 //Image Arithmetic -division, multiplication, image
    subtraction and image addition
2 clc;
3 clear;
4 close;
5 I  = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab
    \scilab\cameraman.jpeg'); //SIVP toolbox
6 J = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
    scilab\rice.jpg');//SIVP toolbox
7 IMA = imadd(I,J); //SIVP toolbox
8 figure
9 ShowImage(IMA,'Image Addition')//IPD toolbox
```

```
10 IMS = imabsdiff(I,J);//SIVP toolbox
11 figure
12 ShowImage(IMS,'Image Subtraction');//IPD toolbox
13 IMD = imdivide(I,J);//SIVP toolbox
14 IMD = imdivide(IMD,0.01);//SIVP toolbox
15 figure
16 ShowImage(uint8(IMD),'Image Division');//IPD toolbox
17 IMM = immultiply(I,I);//SIVP toolbox
18 figure
19 ShowImage(uint8(IMM),'Image Multiply');//IPD toolbox
```

---

check Appendix AP 1 for dependency:

`cameraman.jpeg`

check Appendix AP 4 for dependency:

`lenna.jpg`

Scilab code Solution 2.2 Exp2b

```
1 //Image Arithmetic- Distance and Connectivity: To
     understand the notion of connectivity
2 //and neighborhood defined for a point in an image.
3 clc;
4 clear;
5 close;
6 //function to convert gray to binary
7 function X = gray2bin(x)
8     xmean = mean2(x);
9     [m,n]= size(x);
10    X = zeros(m,n);
11    for i = 1:m
```

Figure 2.1: Exp2a

Figure 2.2: Exp2a

```
12          for j = 1:n
13              if x(i,j)> xmean then
14                  X(i,j) = 1;
15              end
16          end
17      end
18  endfunction
19  //function to find total length of two dimensional
       matrix
20  function n = numdims(X)
21      n = length(size(X));
22  endfunction
23  ////////////////////////////////////
24  //Funtion to pad zeros in columns and rows at both
       ends of an binary image
25  function B = padarray(b)
26      //pad zeros in columns and rows at both ends of
          an binary image
27  [m,n] = size(b);
28  num_dims = length(size(b));
29  B = zeros(m+num_dims,n+num_dims);
30  for i = num_dims:m+num_dims-1
31      for j = num_dims:m+num_dims-1
32          B(i,j) = b(i-1,j-1);
33      end
34  end
35  endfunction
36  ////////////////////////////////////
37  //[1].Euclidean Distance between images and their
       histograms
38  I = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\lenna.jpg');
39  J = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\cameraman.jpeg')
40  h_I = CreateHistogram(I);//IPD toolbox
41  h_J = CreateHistogram(J);//IPD toolbox
42  I = double(I);
43  J = double(J);
```

```
44 E_dist_Hist = sqrt(sum((h_I-h_J).^2));//Euclidean
      Distance between histograms of two images
45 E_dist_images = sqrt(sum((I(:)-J(:)).^2));//
      Euclidean Distance between two images
46 disp(E_dist_images,'Euclidean Distance between two
      images');
47 disp(E_dist_Hist,'Euclidean Distance between
      histograms of two images')
48 //[2]. Connectivity - 8 connected to the background
49 //exec(gray2bin)
50 Ibin = gray2bin(I);
51 Jbin = gray2bin(J);
52 //conversion of gray image into binary image
53 conn = [1,1,1;1,1,1;1,1,1];//8-connectivity
54 //exec('C:\Users\senthilkumar\Desktop\Gautam_PAL_Lab
      \numdims.sci')
55 num_dims = numdims(I);
56 //exec('C:\Users\senthilkumar\Desktop\Gautam_PAL_Lab
      \padarray.sci')
57 B = padarray(Ibin);
58 global FILTER_ERODE;
59 StructureElement = CreateStructureElement('square',
      3);
60 B_eroded = MorphologicalFilter(B,FILTER_ERODE,
      StructureElement.Data);//IPD toolbox
61 //note:StructureElement.Data and conn both are same
      values
62 //except that StructureElement.Data is boolean
      either true or false
63 p = B&~B_eroded;
64 [m,n] = size(p);
65 for i = num_dims:m+num_dims-2
66     for j = num_dims:n+num_dims-2
67         pout(i-1,j-1) = p(i,j);
68     end
69 end
70 figure
71 ShowImage(uint8(I),'Gray Lenna Image')
```

```
72 figure
73 ShowImage(Ibin,'Binary Lenna Image')
74 figure
75 ShowImage(pout,'8 neighbourhood connectiviy in Lenna
       Image')
76 //RESULT
77 //Euclidean Distance between two images
78 //
79 //     19797.433
80 //
81 // Euclidean Distance between histograms of two
      images
82 //
83 //     5770.7
```

Figure 2.3: Exp2b

Figure 2.4: Exp2b

Experiment: 3

Program for Image sharpening.

Scilab code Solution 3.1 Exp3a

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 //2.Program to sharpen image
7 //Read image and display it.
8 //For Colour Image
9 clc;
10 clear all;
11 close;
12 a = imread('C:\Users\senthilkumar\Desktop\
     signal_processing_lab\hestian.jpg');
13 ShowColorImage(a,'Original Image')
14 title('Original Image');
15 //Sharpen the image and display it.
16 //b = imsharpen(a);
17 //figure, imshow(b), title('Sharpened Image');
18
19
```

```
radius =1;
amount = 0.8000;
threshold = 0;
// Gaussian blurring filter
filtRadius = ceil(radius*2);
filtSize = 2*filtRadius + 1;
gaussFilt = fspecial('gaussian',[filtSize filtSize],
   radius);
// High-pass filter
sharpFilt = zeros(filtSize,filtSize);
sharpFilt(filtRadius+1,filtRadius+1) = 1;
sharpFilt = sharpFilt - gaussFilt;
sharpFilt = amount*sharpFilt;
sharpFilt(filtRadius+1,filtRadius+1) = sharpFilt(
   filtRadius+1,filtRadius+1) + 1;
B = imfilter(a,sharpFilt);
figure
ShowColorImage(B,'Sharpened Image');
```

---

check Appendix AP 3 for dependency:

hestian.jpg

Scilab code Solution 3.2 Exp3b

```
//Note: Details of scilab software version and OS
   version used:
//OS: Windows 7
//Scilab version: 5.4.1
//IPD Atom version:8.3.1-2
//SIVP Atom version:0.5.3.1-2
//2.b.Program to sharpen image
```

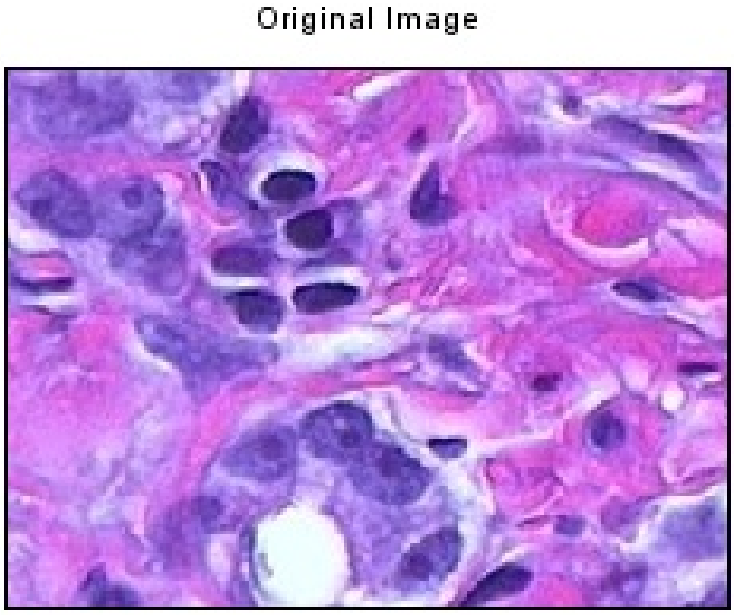


Figure 3.1: Exp3a

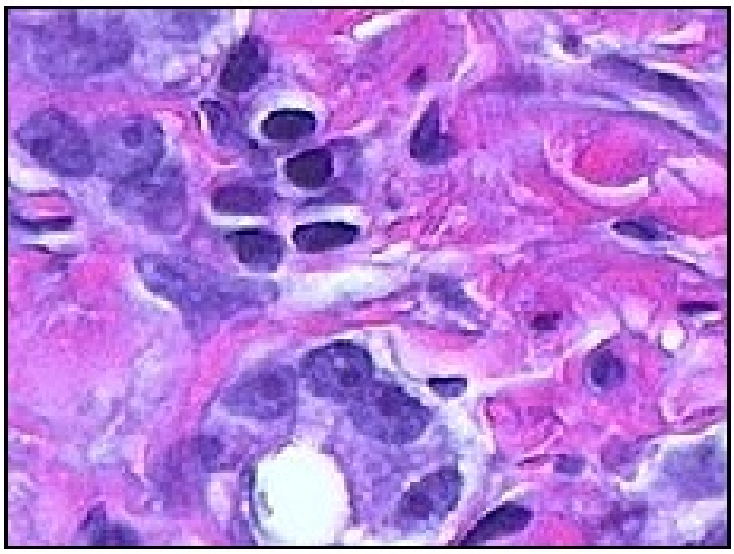


Figure 3.2: Exp3a

```
7  //Read image and display it.
8  //For Gray Image
9  clc;
10 clear all;
11 close;
12 a = imread('C:\Users\senthilkumar\Desktop\
       signal_processing_lab\rice.jpg');//SIVP toolbox
13 ShowImage(a,'Original Image')//SIVP toolbox
14 title('Original Image');
15 //Sharpen the image and display it.
16 //b = imsharpen(a);
17 //figure, imshow(b), title('Sharpened Image');
18
19
20 radius =1;
21 amount = 0.8000;
22 threshold = 0;
23 // Gaussian blurring filter
24 filtRadius = ceil(radius*2);
25 filtSize = 2*filtRadius + 1;
26 gaussFilt = fspecial('gaussian',[filtSize filtSize],
       radius);
27 // High-pass filter
28 sharpFilt = zeros(filtSize,filtSize);
29 sharpFilt(filtRadius+1,filtRadius+1) = 1;
30 sharpFilt = sharpFilt - gaussFilt;
31 sharpFilt = amount*sharpFilt;
32 sharpFilt(filtRadius+1,filtRadius+1) = sharpFilt(
       filtRadius+1,filtRadius+1) + 1;
33 B = imfilter(a,sharpFilt);
34 figure
35 ShowImage(B,'Sharpened Image');//IPD toolbox
```

---

check Appendix AP 2 for dependency:

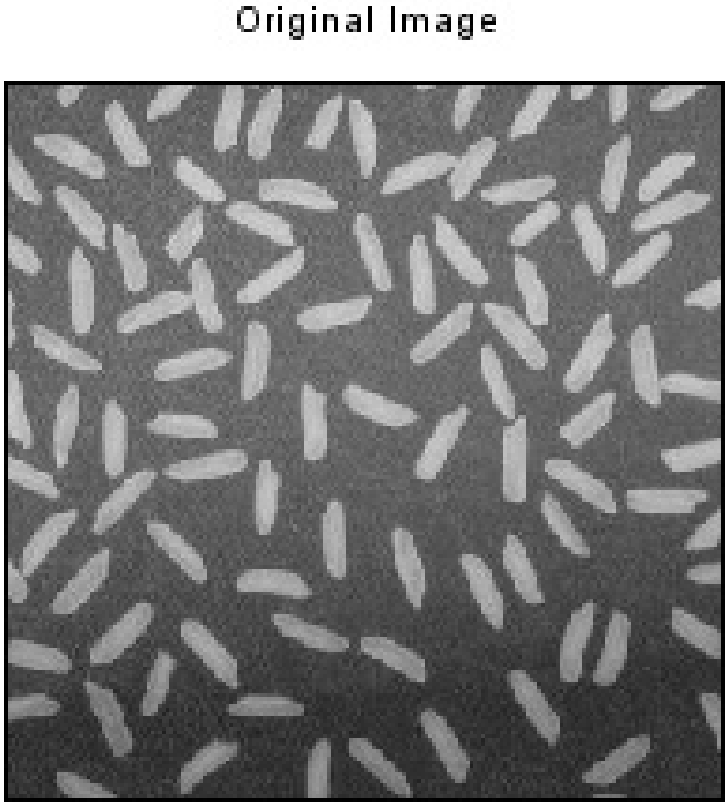


Figure 3.3: Exp3b

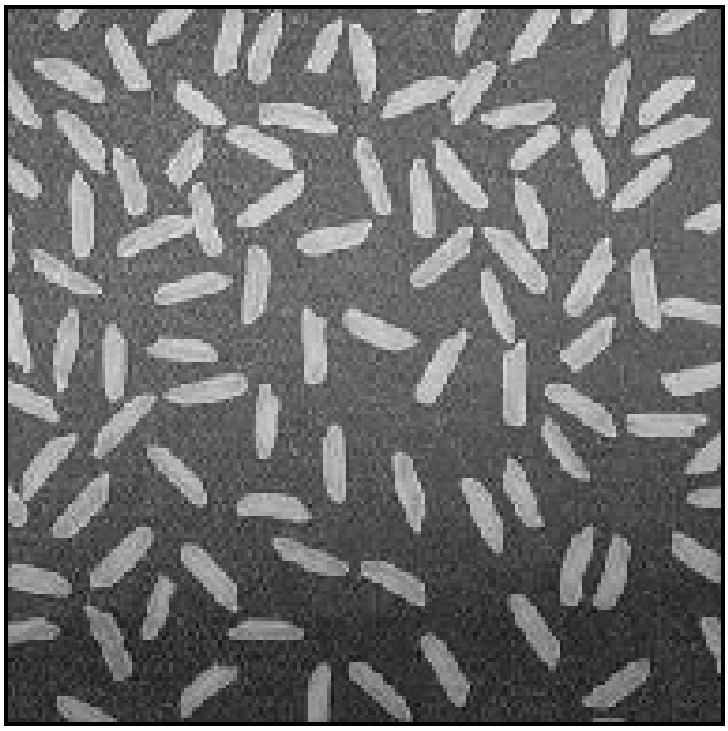


Figure 3.4: Exp3b

rice.jpg

Experiment: 4

Program for lossless Image Compression.

Scilab code Solution 4.1 Exp4

```
1 // Lossless Image Compression- Implementation of
    arithmetic coding for images
2 //Note 1: In order to run this program download
    Huffman toolbox from
3 //scilab atoms
4 //Note 2: The Huffman atom is used to encode images
```

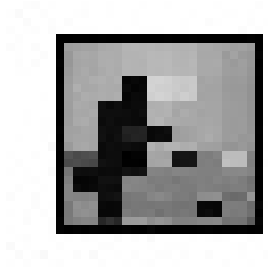


Figure 4.1: Exp4

```
    of small size only
//Software version
//OS Windows7
//Scilab5.4.1
//Image Processing Design Toolbox 8.3.1-1
//Scilab Image and Video Proccessing toolbox
    0.5.3.1-2
clear;
clc;
close;
a = imread('C:\Users\senthilkumar\Desktop\Chaya_Lab\
    scilab\cameraman.jpeg');
A = imresize(a,[16 16]); //Only Image of small size
    is possible to call huffcode
B = size(A);
A=A(:).';
A = double(A);
[QT,QM]=huffcode(A); //Huffman Encoding
disp('compressed Bit sequence:');
disp(QT);
disp('Code Table:');
disp(QM);
// Now, the reverse operation
C = huffdeco(QT,QM); //Huffman Decoding
for i=1:B(1)
    E(i,1:B(2))= C((i-1)*B(2)+1:i*B(2));
end
D = E';
E = imresize(D,[32,32]);
figure
ShowImage(a,'Original cameraman Image 256x256')
figure
ShowImage(E,'Reconstructed cameraman Image 32x32');
```

check Appendix AP 1 for dependency:

`cameraman.jpeg`

Experiment: 5

Program for lossy Image Compression.

Scilab code Solution 5.1 Exp5

```
1  //Lossy Image Compression-Block Truncation Coding
2  //Note: Details of scilab software version and OS
       version used:
3  //OS: Windows 7
4  //Scilab version: 5.4.1
5  //IPD Atom version:8.3.1-2
6  //SIVP Atom version:0.5.3.1-2
7  clc;
8  clear;
9  close;
10 function out_put = btcimage(in_put,block_size)
11     //Note: Details of scilab software version and
         OS version used:
12 //OS: Windows 7
13 //Scilab version: 5.4.1
14 //IPD Atom version:8.3.1-2
15 //SIVP Atom version:0.5.3.1-2
16 X= imread(in_put);
17 Y=imfinfo(in_put);
```

```
18 K=block_size;
19 X1=double(X);
20 y1=size(X);
21 n=y1(1);
22 m=y1(2);
23 k=1;l=1;
24
25
26     if (Y.ColorType=='grayscale')
27
28     //                          IMAGE ENCODING
29
30     //
31     //                    FOR GRAY SCALE IMAGES
32     //
33         figure(1)
34         ShowImage(X,'Original')
35         title('ORIGINAL');
36         for i=1:K:n
37             for j=1:K:m
38                 tmp([1:K],[1:K])=X1([i:i+(K-1)],[j:j
                       +(K-1)]);
39                 mn=mean(mean(tmp));
40                 tmp1([i:i+(K-1)],[j:j+(K-1)])=tmp>mn
                       ;
41                 Lsmat=(tmp<mn);
42                 Mrmat=(tmp>=mn);
43                 Lsmn=sum(sum(Lsmat));
44                 Mrmn=sum(sum(Mrmat));
45                 Mu(k)=sum(sum(Lsmat.*tmp))/(Lsmn+.5)
                       ;k=k+1;
46                 Mi(l)=sum(sum(Mrmat.*tmp))/Mrmn;l=l
                       +1;
47             end
48         end
49         figure(2)
50         ShowImage(tmp1,'Encoded Image')
51         title('ENCODED');
```

```
52
53          //                          IMAGE DECODING
54
55          k=1;l=1;
56          for i=1:K:n
57              for j=1:K:m
58                  tmp21([1:K],[1:K])=tmp1([i:i+(K-1)
                        ],[j:j+(K-1)]);
59                  tmp22=(tmp21*round(Mu(k)));k=k+1;
60                  tmp21=((tmp21==0)*round(Mi(l)));l=l
                        +1;
61                  tmp21=tmp21+tmp22;
62                  out_put([i:i+(K-1)],[j:j+(K-1)])=
                        tmp21;
63              end
64          end
65          figure(3)
66          ShowImage(uint8(out_put),'Decoded Image')
67          title('DECODED');
68
69      //
70      //                      FOR COLORED IMAGES
71      //
72
73      elseif (Y.ColorType=='truecolor')
74          R=X(:,:,1);
75          G=X(:,:,2);
76          B=X(:,:,3);
77          //                      IMAGE ENCODING
78          figure(1)
79          ShowColorImage(X,'Original')
80          title('ORIGINAL');
81          for b=1:3
82              for i=1:K:n
83                  for j=1:K:m
84                      tmp([1:K],[1:K])=X1([i:i+(K-1)
                            ],[j:j+(K-1)],b);
85                      mn=mean(mean(tmp));
```

```
86                          tmp1([i:i+(K-1)],[j:j+(K-1)],b)=
                               tmp>mn;
87                          Lsmat=(tmp<mn);
88                          Mrmat=(tmp>=mn);
89                          Lsmn=sum(sum(Lsmat));
90                          Mrmn=sum(sum(Mrmat));
91                          Mu(b,k)=sum(sum(Lsmat.*tmp))/(
                               Lsmn+.5);k=k+1;
92                          Mi(b,l)=sum(sum(Mrmat.*tmp))/
                               Mrmn;l=l+1;
93                      end
94                  end
95              end
96          end
97  endfunction
98
99  //MAIN PROGRAM
100 I = 'C:\Users\senthilkumar\Desktop\Chaya_Lab\scilab\
       cameraman.jpeg';
101 block_size = 2;
102 //exec('btcimage.sci')
103 //exec('C:\Users\senthilkumar\Desktop\Chaya_Lab\
       scilab\btcimage.sci');
104 out_put = btcimage(I,block_size);
```

check Appendix AP 1 for dependency:

cameraman.jpeg

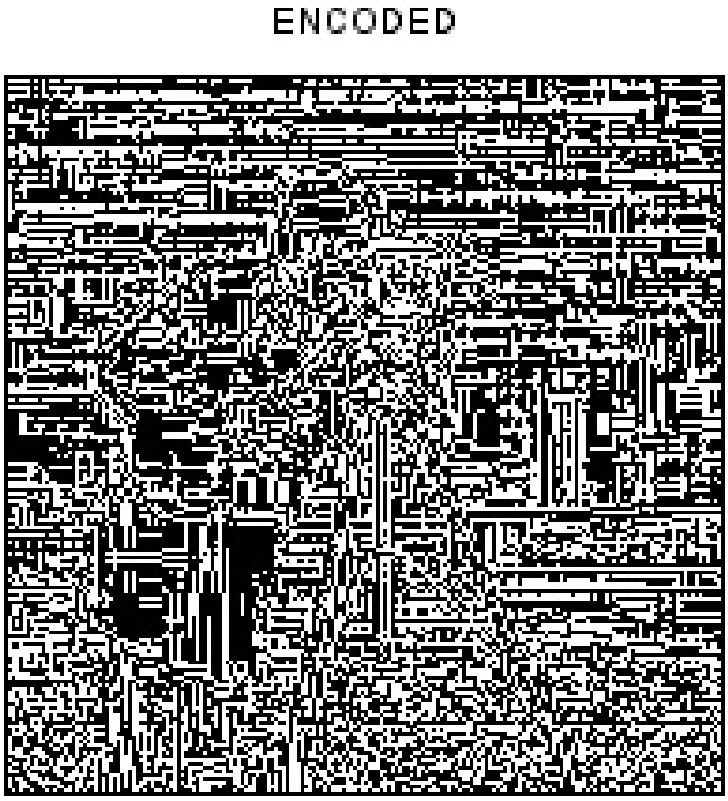


Figure 5.1: Exp5

Figure 5.2: Exp5

Experiment: 6

Program for generation and Manipulation of signal.

Scilab code Solution 6.1 Exp6a

```
1 //Caption: Program to generate and plot different
     basic sequences
2 clear all;
3 clc;
4 close;
5 //Generation of Unit Impulse signal
6 L = 4;  //Upperlimit
7 n = -L:L;
8 x = [zeros(1,L),1,zeros(1,L)];
9
10 b = gca();
11 b.y_location = "middle";
12 plot2d3('gnn',n,x)
13 a=gce();
14 a.children(1).thickness =4;
15 xtitle('Graphical Representation of Unit Sample
     Sequence','n','x[n]');
16 //Generation of Unit Step Signal
17 L = 10;  //Upperlimit
```

```
18 t = -L:L;
19 x = [zeros(1,L),ones(1,L+1)];
20 figure(1)
21 subplot(2,1,1)
22 a=gca();
23 a.thickness =2;
24 a.y_location = "middle";
25 plot2d2(t,x)
26 xtitle('Graphical Representation of Unit Step Signal
      ','t','x(t)');
27 //Generation of Unit Step Sequence
28 L = 4;  //Upperlimit
29 n = -L:L;
30 x = [zeros(1,L),ones(1,L+1)];
31 subplot(2,1,2)
32 a=gca();
33 a.thickness = 2;
34 a.y_location = "middle";
35 plot2d3('gnn',n,x)
36 xtitle('Graphical Representation of Unit Step
      Sequence','n','x[n]');
37 //Generation of Ramp Sequence
38 L = 4;  //Upperlimit
39 n = -L:L;
40 x = [zeros(1,L),0:L];
41 figure(2)
42 subplot(2,1,1)
43 b = gca();
44 b.y_location = 'middle';
45 plot2d3('gnn',n,x)
46 a=gce();
47 a.children(1).thickness =2;
48 xtitle('Graphical Representation of Discrete Unit
      Ramp Sequence','n','x[n]');
49 //Generation of Ramp Signal
50 L = 4;  //Upperlimit
51 t = -L:L;
52 x = [zeros(1,L),0:L];
```

```
53 subplot(2,1,2)
54 b = gca();
55 b.y_location = 'middle';
56 plot2d(n,x)
57 a=gce();
58 a.children(1).thickness =2;
59 xtitle('Graphical Representation of Discrete Unit
      Ramp Sequence','t','x(t)');
60 //Generation of Exponentially Increasing signal
61 a =1.5;
62 n = 0:10;
63 x = (a)^n;
64 figure(3)
65 subplot(2,1,1)
66 a=gca();
67 a.thickness = 2;
68 a.x_location = "origin";
69 a.y_location = "origin";
70 plot2d3('gnn',n,x)
71 xtitle('Graphical Representation of Exponential
      Increasing Signal','n','x[n]');
72 //Generation of Exponentailly Decreasing Signal
73 a =0.5;
74 n = 0:10;
75 x = (a)^n;
76 subplot(2,1,2)
77 a=gca();
78 a.thickness = 2;
79 a.x_location = "origin";
80 a.y_location = "origin";
81 plot2d3('gnn',n,x)
82 xtitle('Graphical Representation of Exponential
      Decreasing Signal','n','x[n]');
```

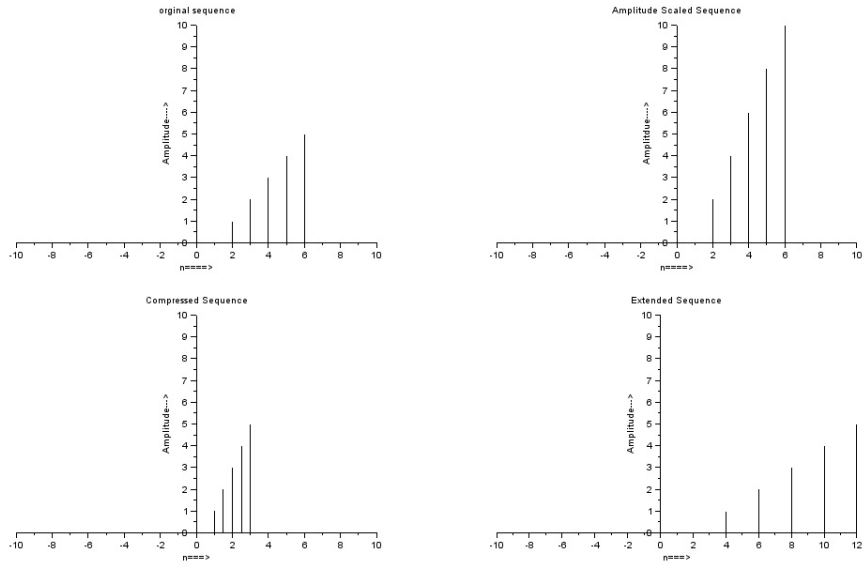


Figure 6.1: Exp6a

Scilab code Solution 6.2 Exp6b

```
1  //Caption: Program to Demonstrate the signal Folding
2  clc;
3  clear;
4  x = input('Enter the input sequence:=');
5  m = length(x);
6  lx = input('Enter the starting point of original
       signal=');
7  hx = lx+m-1;
8  n = lx:1:hx;
9  subplot(2,1,1)
10 a = gca();
11 a.x_location = "origin";
```

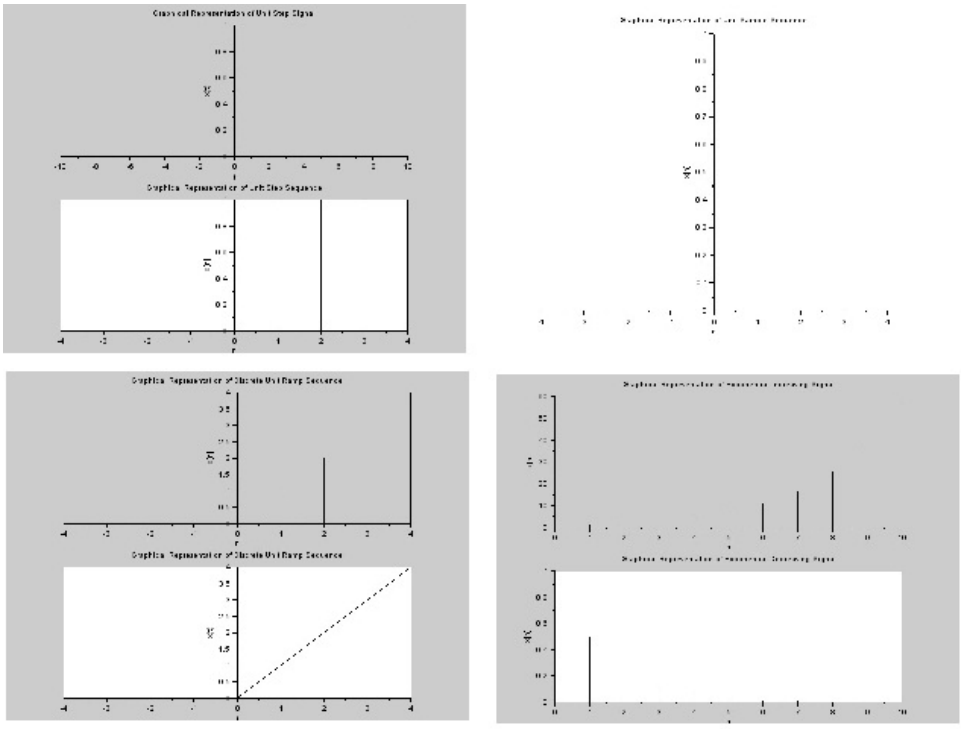


Figure 6.2: Exp6a

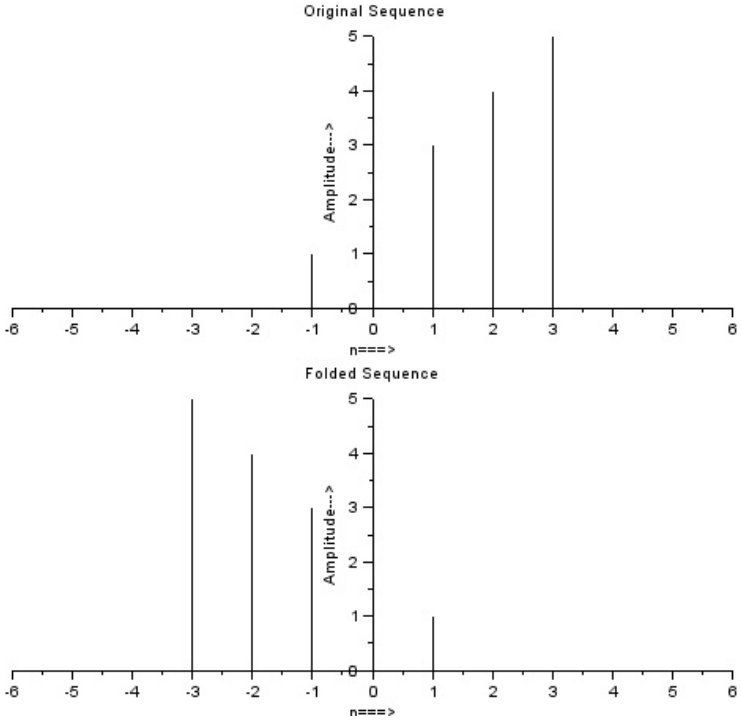


Figure 6.3: Exp6b

```
12 a.y_location = "origin";
13 a.data_bounds = [-5,0;5,5];
14 plot2d3('gnn',n,x)
15 xlabel('n===>')
16 ylabel('Amplitude-->')
17 title('Original Sequence')
18 subplot(2,1,2)
19 a = gca();
20 a.x_location = "origin";
21 a.y_location = "origin";
22 a.data_bounds = [-5,0;5,5];
23 plot2d3(-n,x)
24 xlabel('n===>')
25 ylabel('Amplitude-->')
26 title('Folded Sequence')
27 //Example
28
29 //Enter the input sequence:=[1,2,3,2,5]
30 //
31 //Enter the starting point of original signal=-1
```

Scilab code Solution 6.3 Exp6c

```
1 //Caption: Program to demonstrate the Amplitude &
    Time Scaling of a signal
2 clc;
3 clear;
4 x = input('Enter input Sequence:=');
5 m = length(x);
6 lx = input('Enter starting point of original signal
    :=')
7 hx = lx+m-1;
8 n = lx:1:hx;
```

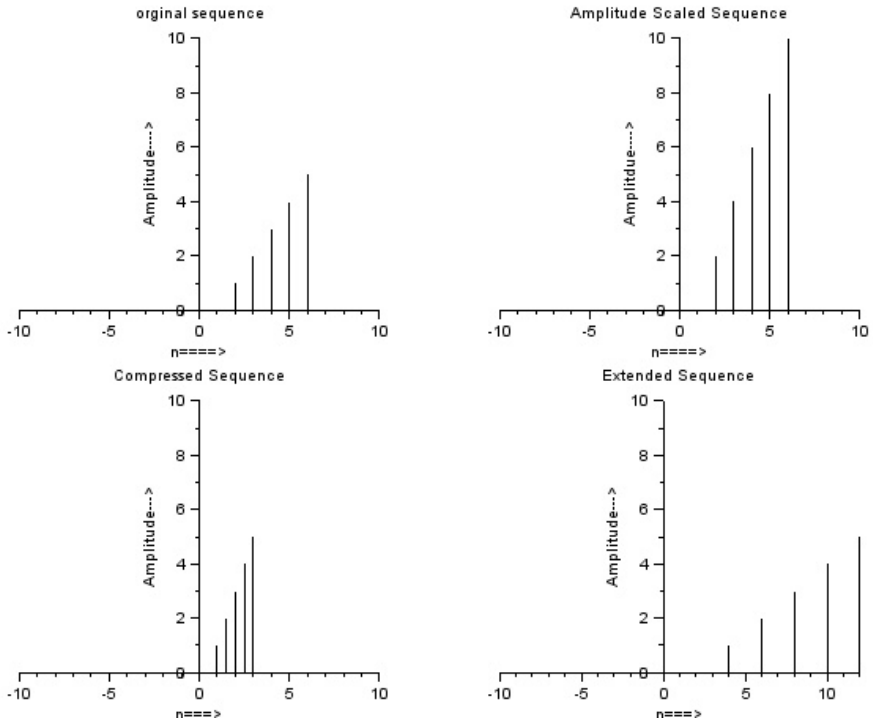


Figure 6.4: Exp6c

```
subplot(2,2,1)
a = gca();
a.x_location = "origin";
a.y_location = "origin";
a.data_bounds = [-10,0;10,10];
plot2d3('gnn',n,x)
xlabel('n====>')
ylabel('Amplitude---->')
title('orginal sequence')
//Amplitude Scaling
a = input('Amplitude Scaling Factor:=')
y =a*x;
subplot(2,2,2)
a = gca();
a.x_location = "origin";
a.y_location = "origin";
a.data_bounds = [-10,0;10,10];
plot2d3('gnn',n,y)
xlabel('n====>')
ylabel('Amplitdue---->')
title('Amplitude Scaled Sequence')
//Time Scaling-Compression
C = input('Enter Compression factor-Time Scaling
    factor')
n = lx/C:1/C:hx/C;
subplot(2,2,3)
a = gca();
a.x_location = "origin";
a.y_location = "origin";
a.data_bounds = [-10,0;10,10];
plot2d3('gnn',n,x)
xlabel('n===>')
ylabel('Amplitude--->')
title('Compressed Sequence')
//Time Scaling-Expansion
d = input('Enter Extension factor-Time Scaling
    factor')
n = lx*d:d:hx*d;
```

```
45 subplot(2,2,4)
46 a = gca();
47 a.x_location = "origin";
48 a.y_location = "origin";
49 a.data_bounds = [-10,0;10,10];
50 plot2d3('gnn',n,x)
51 xlabel('n===>')
52 ylabel('Amplitude-->')
53 title('Extended Sequence')
54 //Example
55 //Enter input Sequence:=[1,2,3,4,5]
56 //
57 //Enter starting point of original signal:= 2
58 //
59 //Amplitude Scaling Factor:= 2
60 //
61 //Enter Compression factor-Time Scaling factor 2
62 //
63 //Enter Extension factor-Time Scaling factor 2
```

Scilab code Solution 6.4 Exp6d

```
1 //Caption:Program to demonstrate the shifting of the
      discrete time signal
2 clc;
3 clear;
4 close;
5 x = input('Enter the input sequence:=')
6 m = length(x);
7 lx = input('Enter the starting point of original
     signal:=')
8 hx = lx+m-1;
9 n = lx:1:hx;
```

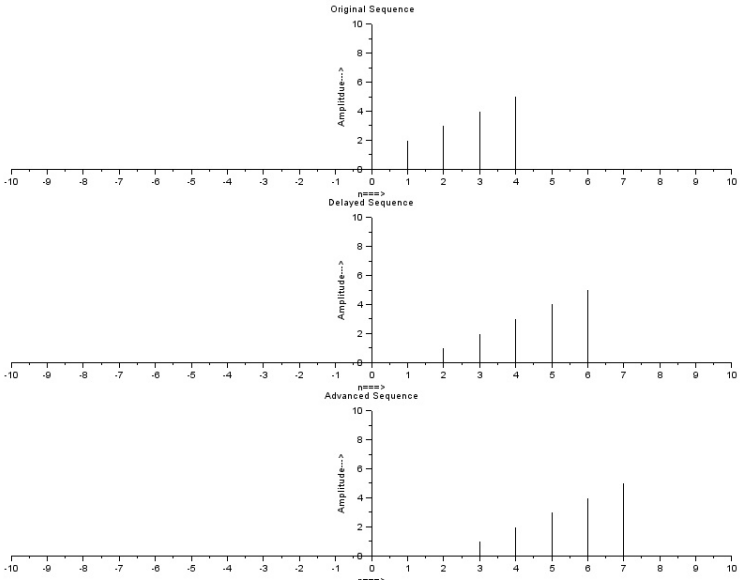


Figure 6.5: Exp6d

```
10 subplot(3,1,1)
11 a = gca();
12 a.x_location = "origin";
13 a.y_location = "origin";
14 a.data_bounds = [-10,0;10,10];
15 plot2d3('gnn',n,x);
16 xlabel('n===>')
17 ylabel('Amplitdue--->')
18 title('Original Sequence')
19 //
20 d = input('Enter the delay:=')
21 n = lx+d:1:hx+d;
22 subplot(3,1,2)
23 a = gca();
24 a.x_location = "origin";
25 a.y_location = "origin";
26 a.data_bounds = [-10,0;10,10];
27 plot2d3('gnn',n,x)
28 xlabel('n===>')
```

```
29 ylabel('Amplitude---->')
30 title('Delayed Sequence')
31 //
32 a = input('Enter the advance:=')
33 n = lx-a:1:hx-a;
34 subplot(3,1,3)
35 a = gca();
36 a.x_location = "origin";
37 a.y_location = "origin";
38 a.data_bounds = [-10,0;10,10];
39 plot2d3('gnn',n,x)
40 xlabel('n===>')
41 ylabel('Amplitude---->')
42 title('Advanced Sequence')
43 //Example
44 //Enter the input sequence:=[1,2,3,4,5]
45 //
46 //Enter the starting point of original signal:=0
47 //
48 //Enter the delay:=2
49 //
50 //Enter the advance:=3
```

Experiment: 7

Program for Discrete Fourier Transform

Scilab code Solution 7.1 Exp7

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 //5.PROGRAM TO IMPLEMENT DISCRETE FOURIER TRANSFORM
7 //DFT
8 clc;
9 close;
10 clear all;
11 N=input('Howmany point DFT  do you want?');
12 x2=input('Enter the sequence=');
13 n2=length(x2);
14 c= zeros(N);
15 x2=[x2 zeros(1,N-n2)];
16  for k=1:N
```

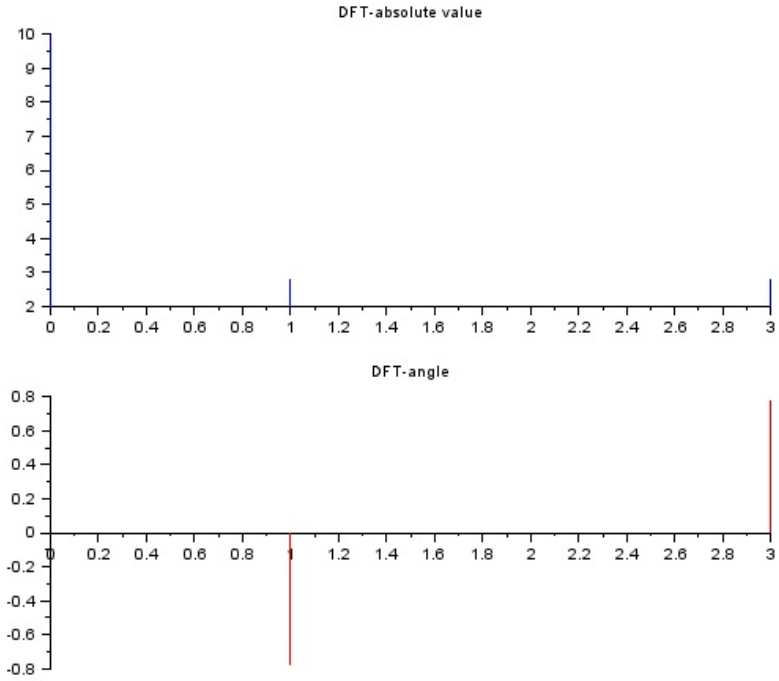


Figure 7.1: Exp7

```
17        for n=1:N
18            w=exp((-2*%pi*%i*(k-1)*(n-1))/N);
19            x(n)=w;
20            c(k,n)=x(n);
21        end
22
23     end
24     r=x2*c;
25    //plotting magnitude and angle
26    subplot(2,1,1)
27    plot2d3('gnn',0:N-1,abs(r),2);
28    title('DFT-absolute value');
29    subplot(2,1,2)
30    a = gca()
31    plot2d3('gnn',0:N-1,atan(imag(r)./(real(r)+0.0001))
      ,5);
32    a.x_location="origin";
33    title('DFT-angle');
34    disp(r,'Discrete Fourier Transform Result')
35    //RESULT
36    //Example 1
37    //Howmany point DFT  do you want? 4
38    //Enter the sequence=[1,2,3,4]
39    //Discrete Fourier Transform Result
40    //     10.  - 2. + 2.i  - 2. - 9.797D-16i  - 2. - 2.i
41    //
42    //Example 2
43    //Howmany point DFT  do you want?8
44    //Enter the sequence=[1,1,1,1,1,1,1,1]
45    //Discrete Fourier Transform Result
46    //           column 1 to 5
47    //
48    //     8.  - 5.551D-16 + 2.220D-16i  - 4.286D-16 -
      4.441D-16i  - 2.220D-16 + 8.882D-16i  - 4.899D-16
      i
49    //
50    //          column 6 to 8
51    //
```

```
52 //  - 2.109D-15 - 1.221D-15i  - 2.933D-15 - 6.661D
      -16i     3.553D-15 + 1.110D-15i
53 //
54 //Example 3
55 //Howmany point DFT  do you want? 8
56 //Enter the sequence= [0,1,2,3,4,5,6,7]
57 //Discrete Fourier Transform Result
58 //
59 //
60 //          column 1 to 7
61 //
62 //    28.  - 4. + 9.6568542i  - 4. + 4.i  - 4. +
      1.6568542i  - 4. - 3.429D-15i  - 4. - 1.6568542i
       - 4. - 4.i
63 //
64 //          column 8
65 //
66 //  - 4. - 9.6568542i
67 //
```

Experiment: 8

Simulation of FIR Filters

Scilab code Solution 8.1 Exp8

```
1  //Caption: To Design an Low Pass FIR Filter
2  //Filter Length =5, Order = 4
3  //Window = Rectangular Window
4  clc;
5  clear;
6  xdel(winsid());
7  fc = input("Enter Analog cutoff freq. in Hz=")
8  fs = input("Enter Analog sampling freq. in Hz=")
9  M = input("Enter order of filter =")
10 w = (2*%pi)*(fc/fs);
11 disp(w,'Digital cutoff frequency in radians.cycles/
       samples');
12 wc = w/%pi;
13 disp(wc,'Normalized digital cutoff frequency in
       cycles/samples');
14 [wft,wfm,fr]=wfir('lp',M+1,[wc/2,0],'re',[0,0]);
15 disp(wft,'Impulse Response of LPF FIR Filter:h[n]=')
       ;
16 //Plotting the Magnitude Response of LPF FIR Filter
```

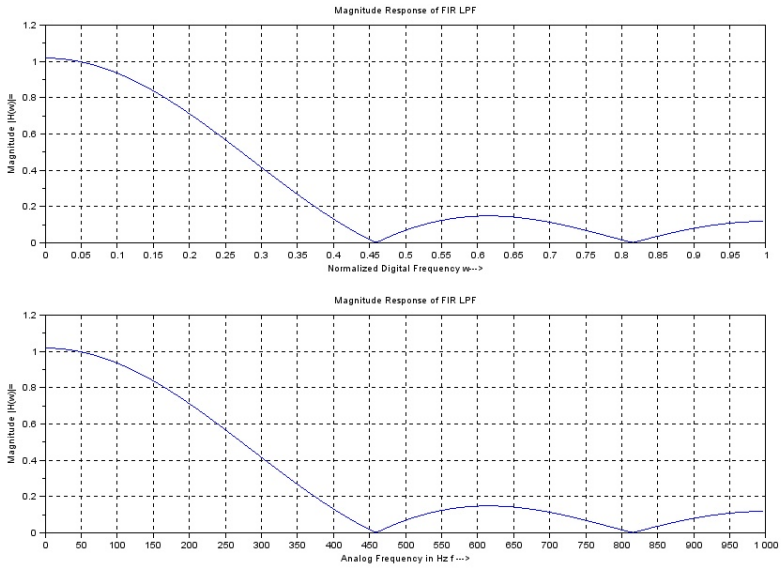


Figure 8.1: Exp8

```
17 subplot(2,1,1)
18 plot(2*fr,wfm)
19 xlabel('Normalized Digital Frequency w---->')
20 ylabel('Magnitude |H(w)|=')
21 title('Magnitude Response of FIR LPF')
22 xgrid(1)
23 subplot(2,1,2)
24 plot(fr*fs,wfm)
25 xlabel('Analog Frequency in Hz f ---->')
26 ylabel('Magnitude |H(w)|=')
27 title('Magnitude Response of FIR LPF')
28 xgrid(1)
29 //Example
30 //Enter Analog cutoff freq. in Hz= 250
31 //
32 //Enter Analog sampling freq. in Hz= 2000
33 //
34 //Enter order of filter = 4
35 //
```

```
36 // Digital cutoff frequency in radians.cycles/
   samples
37 //
38 //    0.7853982
39 //
40 // Normalized digital cutoff frequency in cycles/
   samples
41 //
42 //    0.25
43 //
44 // Impulse Response of LPF FIR Filter:h[n]=
45 //
46 //    0.1591549    0.2250791    0.25    0.2250791
      0.1591549
```

Experiment: 9

Generation and Quantization of Binary Numbers

Scilab code Solution 9.1 Exp9

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 //1.Quantization and sampling
7
8 //Quantize a signal to n bits. This code assumes
     the signal is between -1
9 //and +1.
10 clc;
11 clear all;
12 close;
13 n=8;                          //Number of bits;
14 m= 120;                        //Number of samples;
15 t = 2*%pi*[0:(m-1)]/m;
```

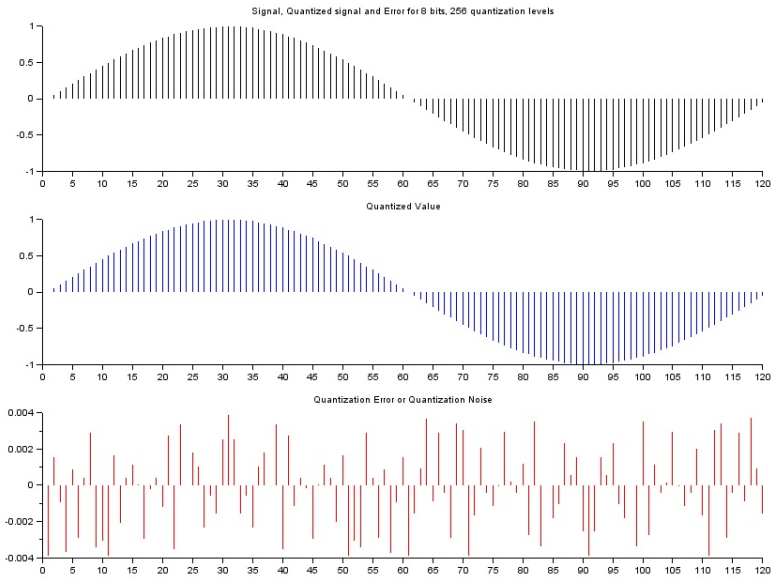


Figure 9.1: Exp9

```
16 x=sin(t);    //signal between -1 and 1.
17                                  //Trying "sin()"
                                       instead of "
                                       sawtooth"
18                                  //results in more
                                       interesting error
                                       (to the
19                                  //extent that error
                                       is interesting).
20 x(find(x>=1))=(1-%eps);       //Make signal from -1
      to just less than 1.
21 xq=floor((x+1)*2^(n-1));    //Signal is one of 2^n
      int values (0 to 2^n-1)
22 xq=xq/(2^(n-1));            //Signal is from 0 to 2 (
      quantized)
23 xq=xq-(2^(n)-1)/2^(n);      //Shift signal down (
      rounding)
24
25 xe=x-xq;                     //Error
```

```
26 subplot(3,1,1)
27 plot2d3('gnn',1:length(x),x);
28 title(sprintf('Signal, Quantized signal and Error
      for %g bits, %g quantization levels',n,2^n));
29 disp(x,'exact value')
30 subplot(3,1,2)
31 plot2d3('gnn',1:length(xq),xq,2);
32 title('Quantized Value')
33 disp(xq,'Quantized value')
34 subplot(3,1,3)
35 plot2d3('gnn',1:length(xe),xe,5);
36 title('Quantization Error or Quantization Noise')
37 disp(xe,'Quantization error or noise')
```

Experiment: 10

Introduction to Simulink Signal Analysis

Scilab code Solution 10.1 Exp10a

```
1 //Step response of discrete time systems
2 //Refer Exp10a.xcos file for simulink analysis
```

This code can be downloaded from the website wwww.scilab.in

Scilab code Solution 10.2 Exp10b

```
1 //Step response of Continuous time systems
2 //Refer Exp10b.xcos file for simulink analysis
```

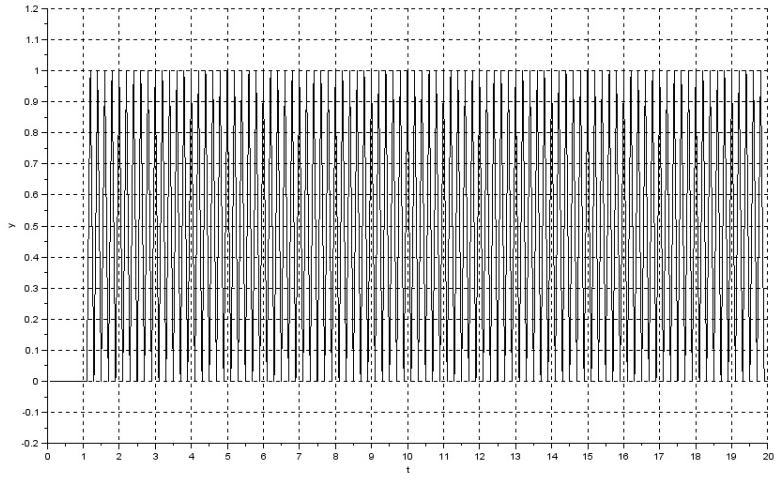


Figure 10.1: Exp10a

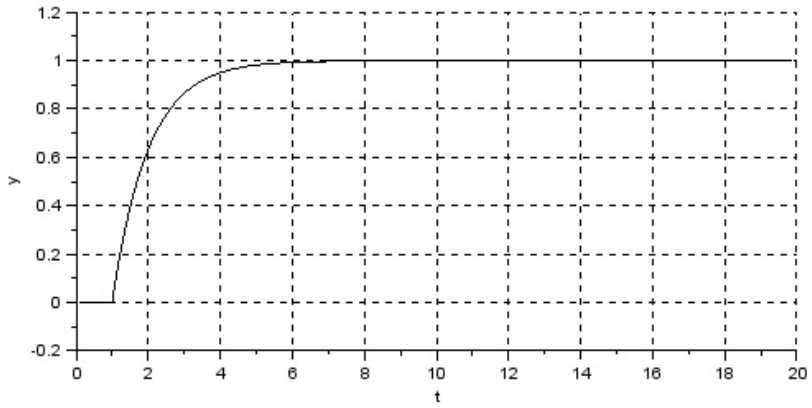


Figure 10.2: Exp10b

This code can be downloaded from the website wwww.scilab.in

Experiment: 11

Design and analysis of Butterworth Filter

Scilab code Solution 11.1 Exp11

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 clc;
7 clear all;
8 close;
9 n = 6; //filter order
10 Wn = [2.5e6,29e6]/500e6; //normalized cutoff
     frequencies[lower,upper]
11 ftype = 'bp'; //bandpass filter
12 fdesign = 'butt'; //Butterworth Filter
13 delta =[];
14 hz=iir(n,ftype,fdesign,Wn/2,delta)
15 [p,z,g]=iir(n,ftype,fdesign,Wn/2,delta)
```

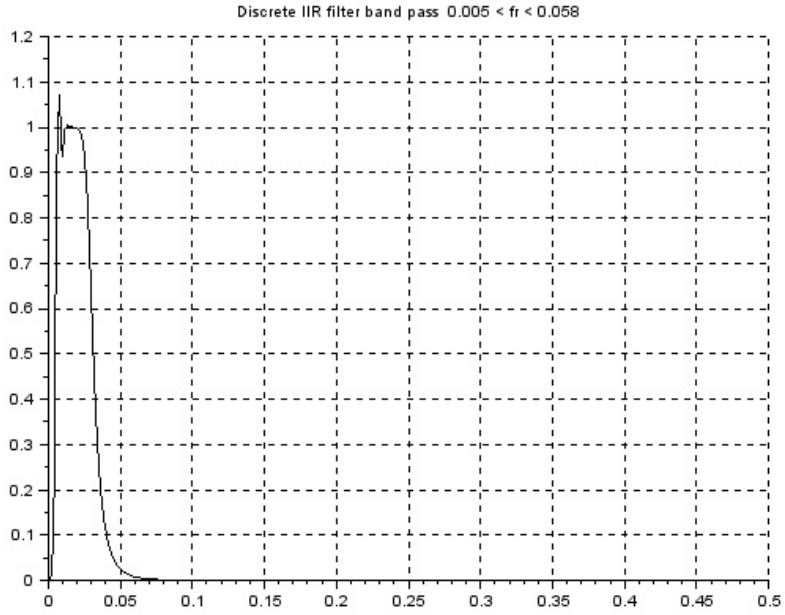


Figure 11.1: Exp11

```
[hzm,fr]=frmag(hz,256);
plot2d(fr',hzm');
xtitle('Discrete IIR filter band pass  0.005 < fr <
   0.058 ',' ',' ');
xgrid(1)
//Result

//-->hz(2)
// ans  =
//
//                              2             4
//     0.0000002 - 0.0000015z + 0.0000037z
//                             6             8
//             - 0.0000049z + 0.0000037z
//                             10            12
//             - 0.0000015z + 0.0000002z
//
//-->hz(3)
// ans  =
//
//                                           2
//     0.5250468 - 6.6287407z + 38.377802z
//                             3             4
//             - 134.73451z + 319.45814z
//                             5             6
//             - 538.91189z + 663.25134z
//                             7             8
//             - 600.03003z + 396.0233z
//                              9            10
//             - 185.96443z + 58.974503z
//                             11  12
//             - 11.340535z + z
//
//-->hz(1)
// ans  =
//
//!r  num  den  dt  !
//
```

```
53 //-->p
54 //  p   =
55 //
56 //      0.9964120 - 0.0154005 i
57 //      0.9892502 - 0.0129619 i
58 //      0.9822499 - 0.0060512 i
59 //      0.9822499 + 0.0060512 i
60 //      0.9892502 + 0.0129619 i
61 //      0.9964120 + 0.0154005 i
62 //      0.9464056 + 0.1686845 i
63 //      0.8907712 + 0.1177110 i
64 //      0.8651786 + 0.0429743 i
65 //      0.8651786 - 0.0429743 i
66 //      0.8907712 - 0.1177110 i
67 //      0.9464056 - 0.1686845 i
68 //
69 //-->z
70 //  z   =
71 //
72 //      1.
73 //      1.
74 //      1.
75 //      1.
76 //      1.
77 //      1.
78 //    - 1.
79 //    - 1.
80 //    - 1.
81 //    - 1.
82 //    - 1.
83 //    - 1.
84 //
85 //-->g
86 //  g   =
87 //
88 //      0.0000002
89 //
```

Experiment: 12

Impulse response of first order and second order system

Scilab code Solution 12.1 Exp12

```
1 //Note: Details of scilab software version and OS
     version used:
2 //OS: Windows 7
3 //Scilab version: 5.4.1
4 //IPD Atom version:8.3.1-2
5 //SIVP Atom version:0.5.3.1-2
6 clc;
7 clear all;
8 close;
9 s=poly(0,'s');
10 //The parameters 1.Angular Position 2. Angular
     Velocity of DC Motors
11 //are obtained from MATLAB demos file.
12 Angular_Position =(0.003127*s+0.9815)/(s^2+3.929*s
     +6.343e-05);
13 Angular_velocity = (1.04*s+0.2756)/(s^2+4.461*s
     +1.096);
```

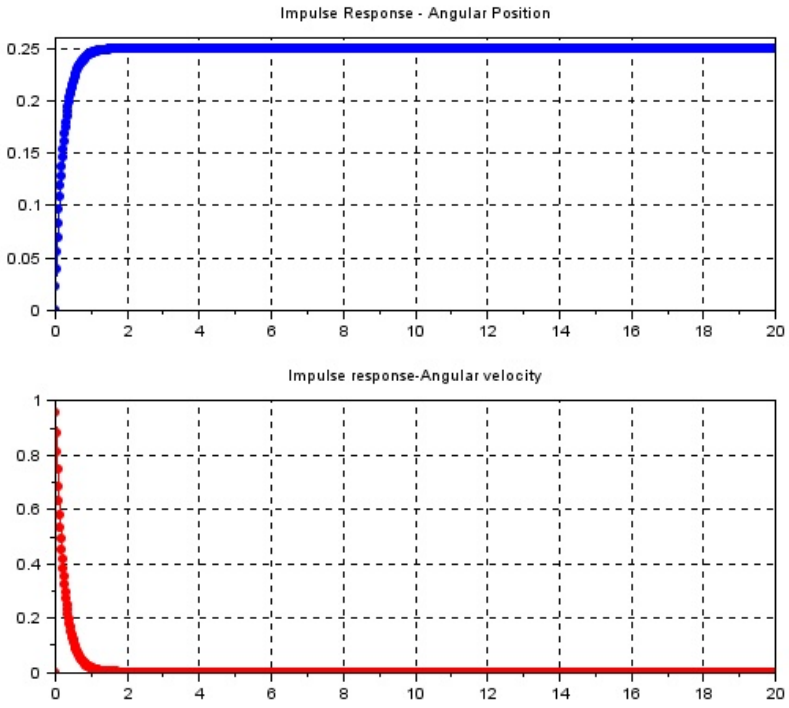


Figure 12.1: Exp12

```
model = [Angular_Position,Angular_velocity];
H1 = model(:,1); //Angular Position
H2 = model(:,2); //Angular velocity
np=20; //number of points
t = 0:0.02:20;
ysd1 = csim('impulse',t,model(:,1));
ysd2 = csim('impulse',t,model(:,2));
subplot(2,1,1)
plot(t,ysd1,'.-b')
title('Impulse Response - Angular Position')
xgrid(1)
subplot(2,1,2)
plot(t,ysd2,'.-r')
title('Impulse response-Angular velocity')
xgrid(1)
disp(model,'Model System Equations =')
disp(ysd1,'Impulse Resposne of Angular Position =')
disp(ysd2,'Impulse Response of Angular velocity=')

//RESULT
//Model System Equations =
//
//      0.9815 + 0.003127s          0.2756 + 1.04s
//    ------------------------    ------------------
//                          2                      2
//    0.0000634 + 3.929s + s     1.096 + 4.461s + s
```

Experiment: 13

Circular convolution of two given sequences.

Scilab code Solution 13.1 Exp13

```
1  //Note: Details of scilab software version and OS
       version used:
2  //OS: Windows 7
3  //Scilab version: 5.4.1
4  //IPD Atom version:8.3.1-2
5  //SIVP Atom version:0.5.3.1-2
6  //3.CIRCULAR CONVOLUTION OF TWO SEQUENCES
7  clc;
8  close;
9  clear all;
10 a1= input('1st Sequence x:')
11 b1= input('2nd Sequence h:')
12 ax=length(a1);
13 bx=length(b1);
14 n=max(ax,bx);
15 n3=ax-bx;
16 if(n3<=0)
```

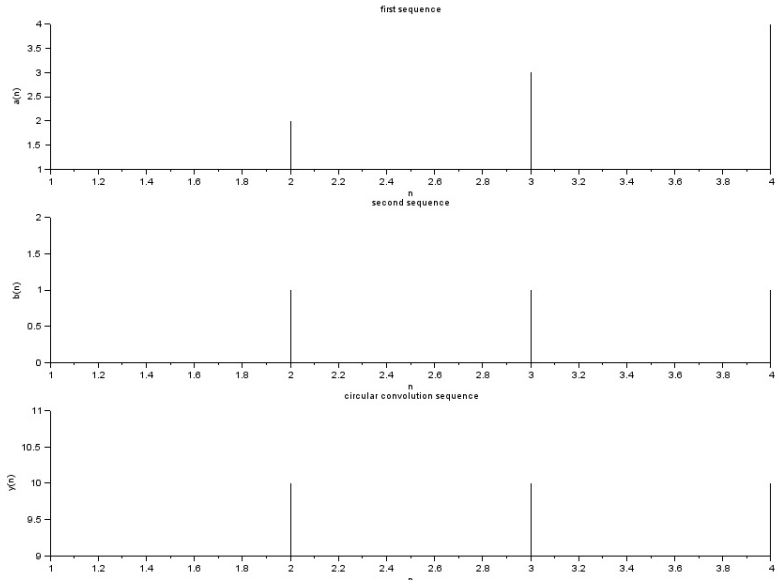


Figure 13.1: Exp13

```
17   a1=[a1,zeros(1,-n3)];
18  else
19   b1=[b1,zeros(1,n3)];
20  end
21  for r = 1:n
22      y(r)=0;
23      for i=1:n
24          j=r-i+1;
25          if (j<=0)
26              j=j+n;
27          end
28          y(r)=y(r)+b1(j)*a1(j);
29      end
30  end
31  disp(y,'circular convloution result')
32
33  subplot(3,1,1);
34  plot2d3('gnn',a1);
35  xlabel('n');
```

```
36 ylabel('a(n)');
37 title('first sequence');
38 subplot(3,1,2);
39 plot2d3('gnn',b1);
40 xlabel('n');
41 ylabel('b(n)');
42 title('second sequence');
43 subplot(3,1,3);
44 plot2d3('gnn',y);
45 xlabel('n');
46 ylabel('y(n)');
47 title('circular convolution sequence');
48
49 //RESULT
50 //Example 1
51 //1st Sequence x:[1,2,3,4]
52 //2nd Sequence h:[1,1,1,1]
53 //
54 // circular convloution result
55 //
56 //    10.    10.    10.    10.
57 //
58 //Example 2
59 //1st Sequence x:[1,2,3,4]
60 //2nd Sequence h:[1,1,1]
61 //
62 // circular convloution result
63 //
64 //    6.    6.    6.    6.
```

Experiment: 14

Linear convolution of two given sequences.

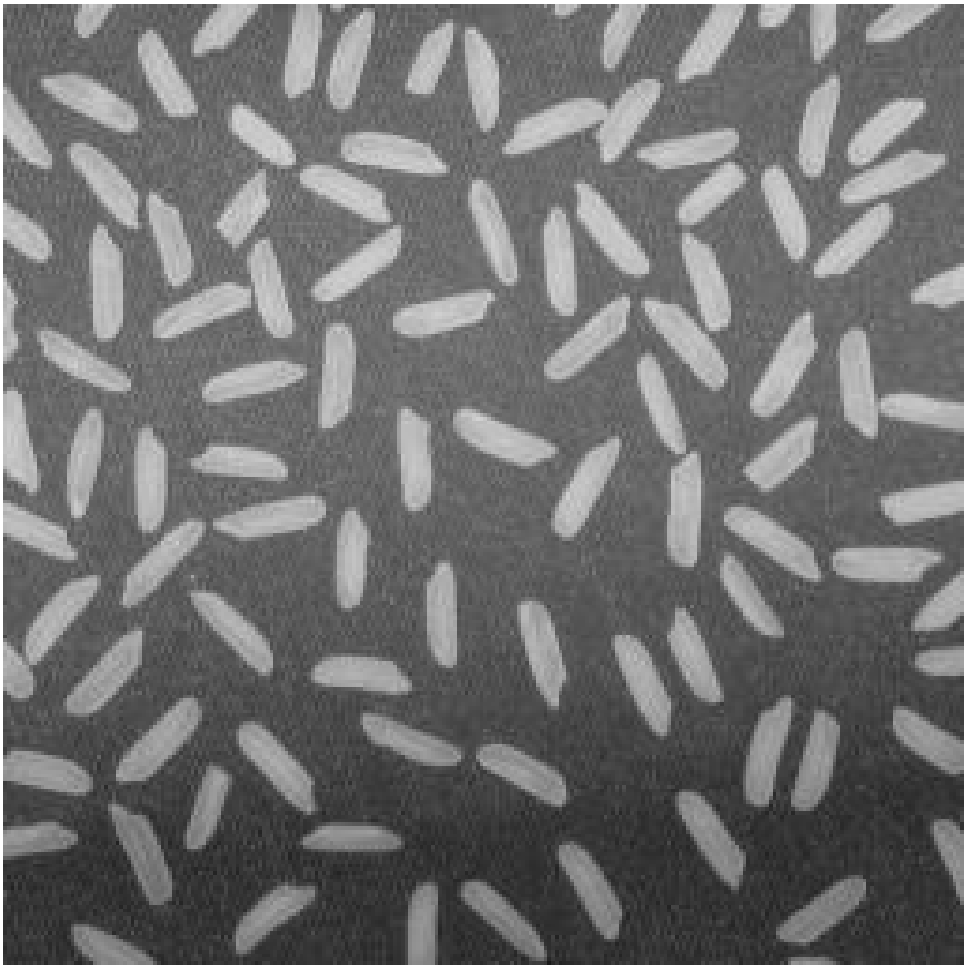
Scilab code Solution 14.1 Exp14

```
1  //Note: Details of scilab software version and OS
       version used:
2  //OS: Windows 7
3  //Scilab version: 5.4.1
4  //IPD Atom version:8.3.1-2
5  //SIVP Atom version:0.5.3.1-2
6  //4.program for linear convolution of to sequence
7  clc;
8  clear all;
9  close;
10 x = input('enter the first sequence');
11 y = input('enter the second sequence');
12 m = length(x);
13 n = length(y);
14 p = m+n-1;
15 for i=1:p
16     q=i;
17     k=0;
18     for j=1:i
```

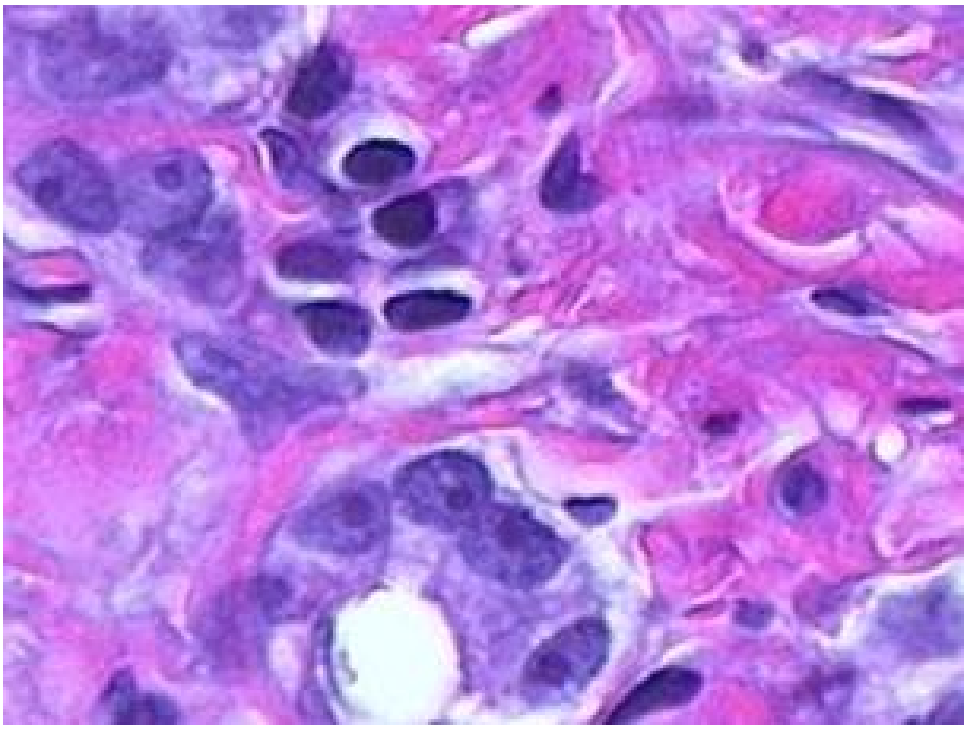
```
19          if q>m
20              q=q-1;
21          elseif j>n
22                  k=k;
23          else k=x(q)*y(j)+k;
24              q=q-1;
25          end
26      end
27      z(i)=k;
28  end
29  disp(z,'convolution of two sequence is:')
30
31  //RESULT
32  //enter the first sequence [1,2,3]
33  //enter the second sequence [1,1,1,1]
34  //
35  // convolution of two sequence is:
36  //
37  //     1.
38  //     3.
39  //     6.
40  //     6.
41  //     5.
42  //     3.
43  //
```

Appendix

Cameraman Image file



Rice Image File



Hestian Colour Image File

Lenna Image File