COMP 478 DD

Piyush Pokharkar

40120654

Assignment 1

Theoretical Questions

1)

Transform is Cumulative Distribution Function: $s = T(r) = (L-1)\int_0^r p_r(\omega)d\omega$

CDF of r:

$T(r) = \int_0^r -2t + 2dt$

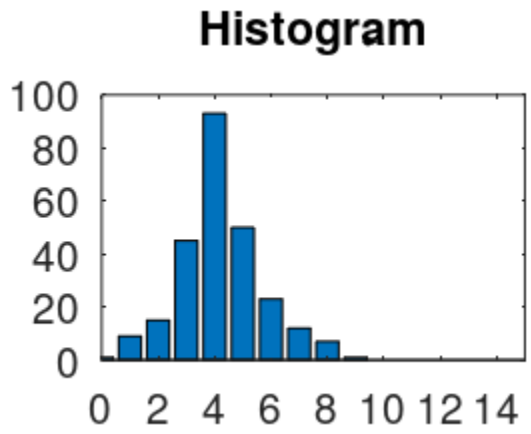
$= |-t^2 + 2t|$ from 0 to r

$= -r^2 + 2r$

The transformation from r to z:

$z = T(r) = -r^2 + 2r$

2.a)



2.b)

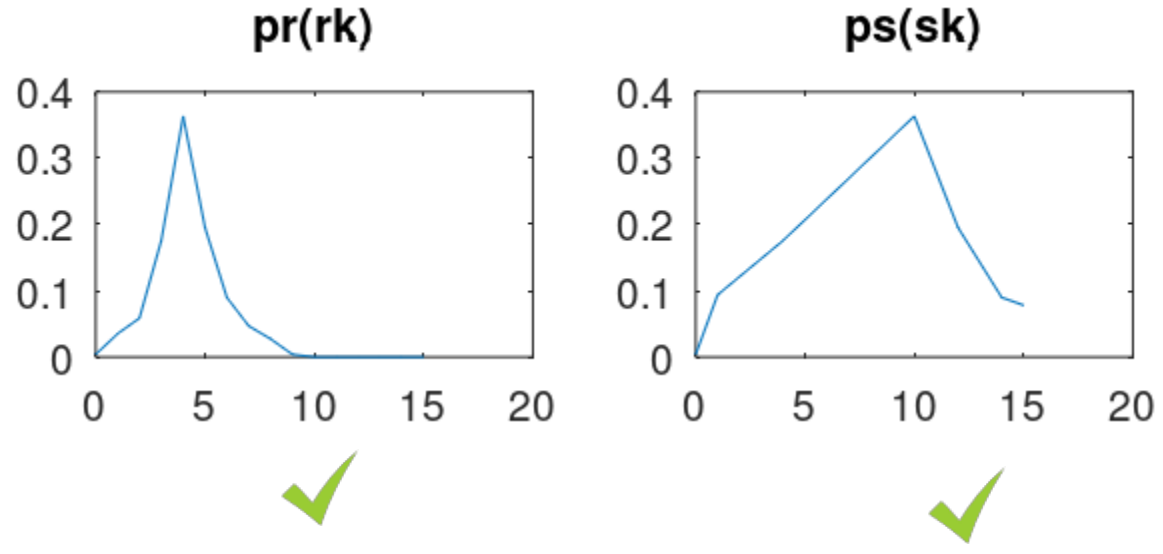
n = 256, L = 15

i)

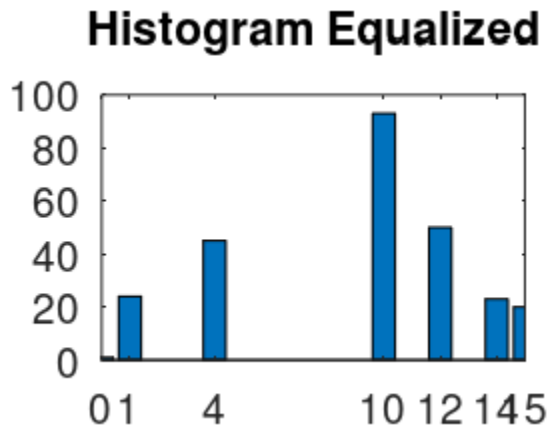
r_k (grey levels)	# of pixels (n_k)	$p_r(r_k) = n_k/n$	$s_k = (L-1)\sum_{j=0}^{k}\frac{n_j}{n}$	s_k (grey levels integers)	n_{sk}	$p_s(s_k)$
0	1	0.00390625	0.05859375	0	1	0.00390625
1	9	0.03515625	0.5859375	1		
2	15	0.05859375	1.46484375	1	24	0.09375
3	45	0.17578125	4.1015625	4	45	0.17578125
4	93	0.36328125	9.55078125	10	93	0.36328125
5	50	0.1953125	12.48046875	12	50	0.1953125
6	23	0.08984375	13.828125	14	23	0.08984375
7	12	0.046875	14.53125	15		
8	7	0.02734375	14.94140625	15		
9	1	0.00390625	15	15		
10	0	0	15	15		
11	0	0	15	15		
12	0	0	15	15		
13	0	0	15	15		
14	0	0	15	15		
15	0	0	15	15	20	0.078125

3.1

ii)



2.c)



3)

By performing the arithmetic operation f(x,y) - g(x,y) the resulting image will lower pixel intensity by c, so it will be darker. The histogram of f(x,y) - g(x,y) will shift to the left by c units, but it will still maintain its shape as the number of pixels will remain the same but will have lower values. Any pixels with value of c or lower will be cut from the histogram because they will have negative values.

4.1

4)

Convert image to binary:

0000	0001	1000	0110
0010	0010	0001	0001
0001	1111	1110	1100
0011	0110	1001	1010

Bit Planes:

0	0	1	0
0	0	0	0
0	1	1	1
0	0	1	1

0	0	0	1
0	0	0	0
0	1	1	1
0	1	0	0

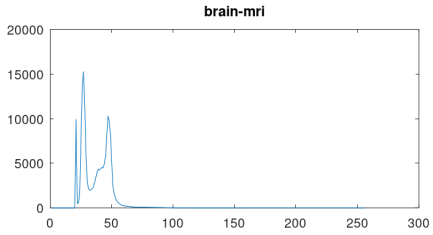
0	0	0	1
1	1	0	0
0	1	1	0
1	1	0	1

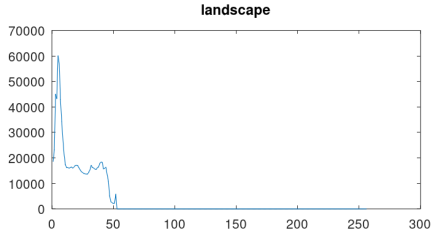
0	1	0	0
0	0	1	1
1	1	0	0
1	0	1	0

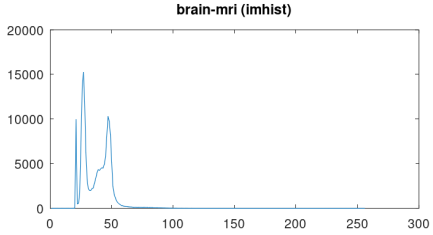
Programming Questions

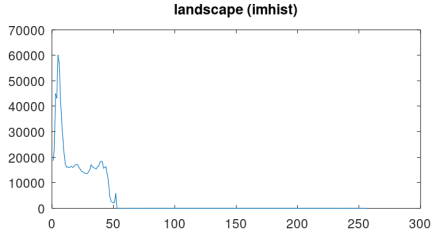
```
pkg load image
pkg load statistics

%% Question 1
% Read the images
brain_mri = imread('brain-mri.png');
landscape = imread('landscape.png');

%% Question 2
% Calculate histograms
H1 = zeros(1, 256);
for i = 1:length(H1)
  H1(i) = sum(sum(brain_mri == i - 1));
endfor

subplot(2,2,1);
plot(H1);
title('brain-mri');

H2 = zeros(1, 256);
for i = 1:length(H2)
  H2(i) = sum(sum(landscape == i - 1));
endfor

subplot(2,2,2);
plot(H2);
title('landscape');

%% Question 3
% Calculate histograms using imhist
histo_brain_mri = imhist(brain_mri);
histo_landscape = imhist(landscape);

subplot(2,2,3);
plot(histo_brain_mri);
title('brain-mri (imhist)');

subplot(2,2,4);
plot(histo_landscape);
title('landscape (imhist)');

% The histograms used by my program look similar to the ones using imhist
```

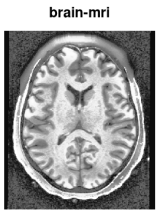
```
%% Question  4
% Calculate cumulative distribution function
cdf = cumsum(H1 / sum(H1));
% Perform equalization
equalized1 = cdf(double(brain_mri)+1);
% Round
equalized1 = uint8(equalized1 * 255);

cdf = cumsum(H2 / sum(H2));
equalized2 = cdf(double(landscape)+1);
equalized2 = uint8(equalized2 * 255);

figure;
subplot(2,2,1);
imshow(equalized1);
title('brain-mri');

subplot(2,2,2);
imshow(equalized2);
title('landscape');


%% Question 5
% Histo Equalization using histeq
hist_eq_brain_mri = histeq(brain_mri);
hist_eq_landscape = histeq(landscape);

subplot(2,2,3);
imshow(hist_eq_brain_mri);
title('brain-mri (histeq)');

subplot(2,2,4);
imshow(hist_eq_landscape);
title('landscape (histeq)');

% The histogram-equalized images obtained using my program look similar to histeq
```

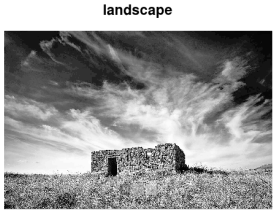

brain-mri
20000
15000
10000
5000
0
0
50
100
150
200
250
300

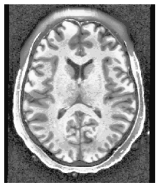

landscape
70000
60000
50000
40000
30000
20000
10000
0
0
50
100
150
200
250
300


brain-mri (imhist)
20000
15000
10000
5000
0
0
50
100
150
200
250
300


landscape (imhist)
70000
60000
50000
40000
30000
20000
10000
0
0
50
100
150
200
250
300


brain-mri


landscape


brain-mri (histeq)


landscape (histeq)

Index of comments

3.1 The numbers for histogram equalization are correct but not in the right rows

4.1 The height of the bins will remain the same.