COMP 478 DD

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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:

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

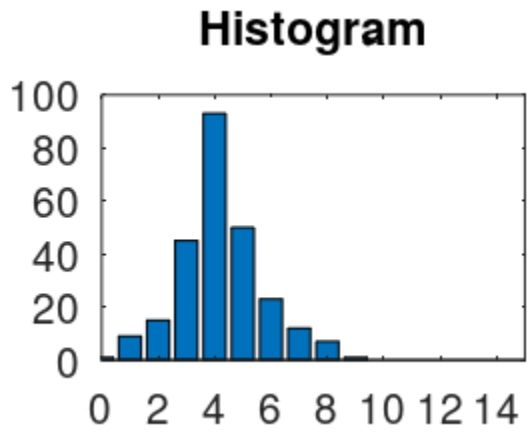
$= |-t^2 + 2t|$ from 0 to r

$= -r^2 + 2r$

The transformation from r to z:

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

2.a)

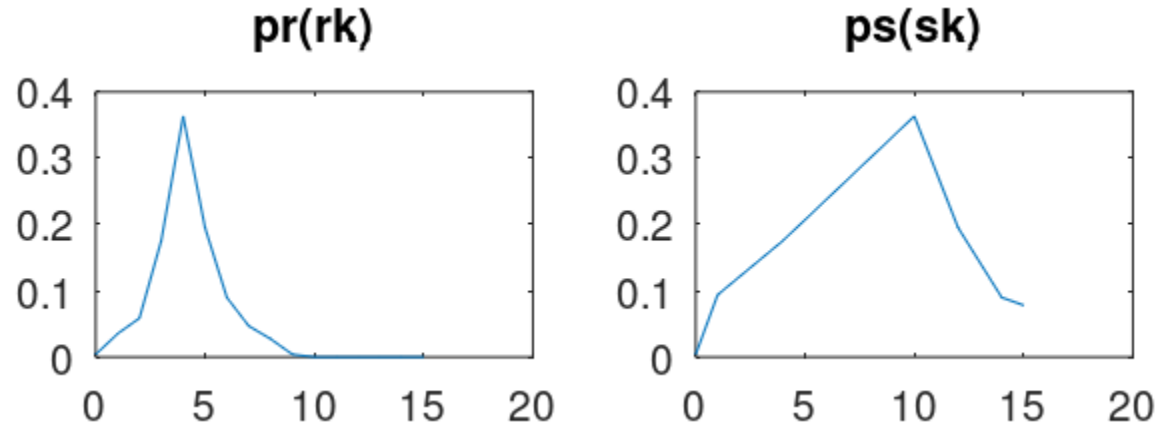


2.b)

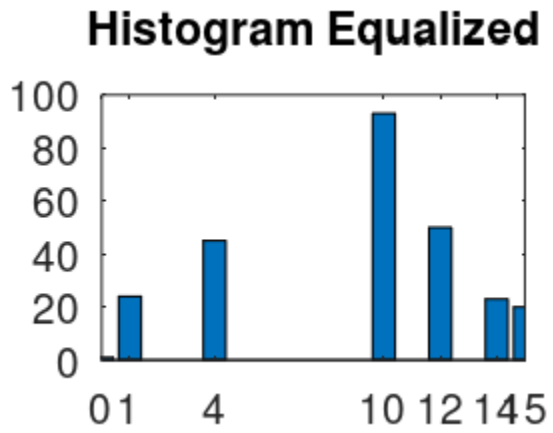
n = 256, L = 15 i)

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

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)

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

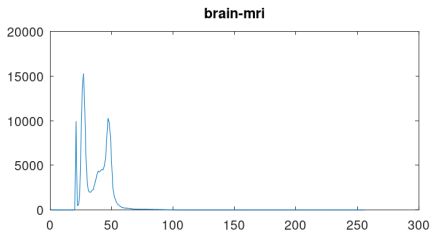
0	0	0	1
1	1	0	0
0	1	1	0
1	1	0	1

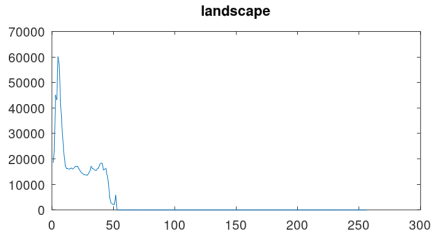
0	1	0	0
0	0	1	1
1	1	0	0
1	0	1	0

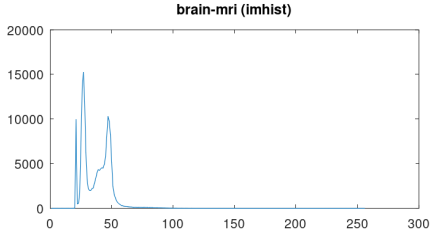
Programming Questions

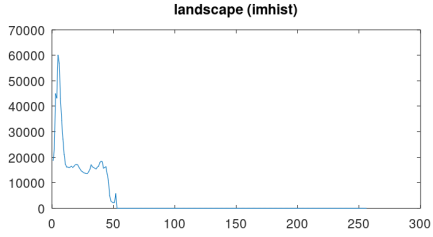
```
pkg load image
pkg load statistics

%% 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
```

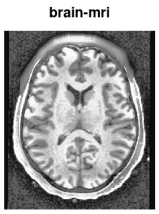
```
%% Question  4
% Calculate cumulative distribution function
cdf = cumsum(H1 / sum(H1));
% Perform equalization
equalized1 = cdf(double(brain_mri)+1);
% Round
equalized1 = uint8(equalized1 * 255);

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
```

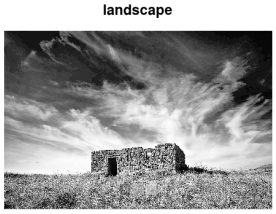

brain-mri
20000
15000
10000
5000
0
0
50
100
150
200
250
300

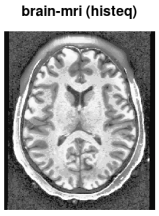

landscape
70000
60000
50000
40000
30000
20000
10000
0
0
50
100
150
200
250
300


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)