ECE-5554 Computer Vision: Problem Set 0

Murat Ambarkutuk
murata@vt.edu

Mechanical Engineering Department,
Virginia Polytechnic Institute and State University

August 31, 2015

Answer Sheet

1 Short Answer Problems

1. Completed.
2. (a) Creates a row vector containing random permutations of numbers in the range of $[1, 1000]$.

   (b) Line 1 Creates matrix $\underline{\mathcal{A}}_{3\times3}$:

$$\underline{\mathcal{A}} = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

   Line 2 assigns the second row of $\underline{\mathcal{A}}$ to the variable b.

$$b = [4, 5, 6]$$

   (c) Line 1 Creates matrix $\underline{\mathcal{A}}_{3\times3}$:

$$\underline{\mathcal{A}} = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

   Line 2 assigns the all the values the variable b in column vector form.

$$\underline{\mathcal{B}} = \begin{bmatrix} 1, & 4, & 7, & 2, & 5, & 8, & 3, & 6, & 9 \end{bmatrix}^T$$

   (d) Line 1 creates the column vector $f_{5\times1}$ with the normally distributed random values.
   Line 2 sets another variable and fills it with the elements of $f_{1\times5}$ which are above 0.

   (e) Line 1 sets a row vector $x_{1\times10}$ with zeros and adds 0.5 to each element of it.

$$x = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} + 0.5$$

$$x = \begin{bmatrix} 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 \end{bmatrix}$$

Line 2 creates another row vector with the same size of vector $x_{1\times10}$, and multiplies each element of new row vector with 0.5.

$$y = [1,1,1,1,1,1,1,1,1,1] \times 0.5$$
$$y = \begin{bmatrix} 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 \end{bmatrix}$$

Line 3 sums vector x and y and assigns the result to z.

$$z = x + y$$
$$z = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

(f) Line 1 creates a row vector $a_{1\times100}$ which contains the sequence starting from 1 to 100 (inclusive).

$$a = [1,2,3,4\ldots98,99,100]$$

Line 2 flips the vector and sets vector b with these values.

$$b = [100,99,98,97\ldots3,2,1]$$

3. (a) The function returning n trials of 6-sided dice roll is given below. (Please find the diceTrials.m file .zip file.) The contents of diceTrials.m:

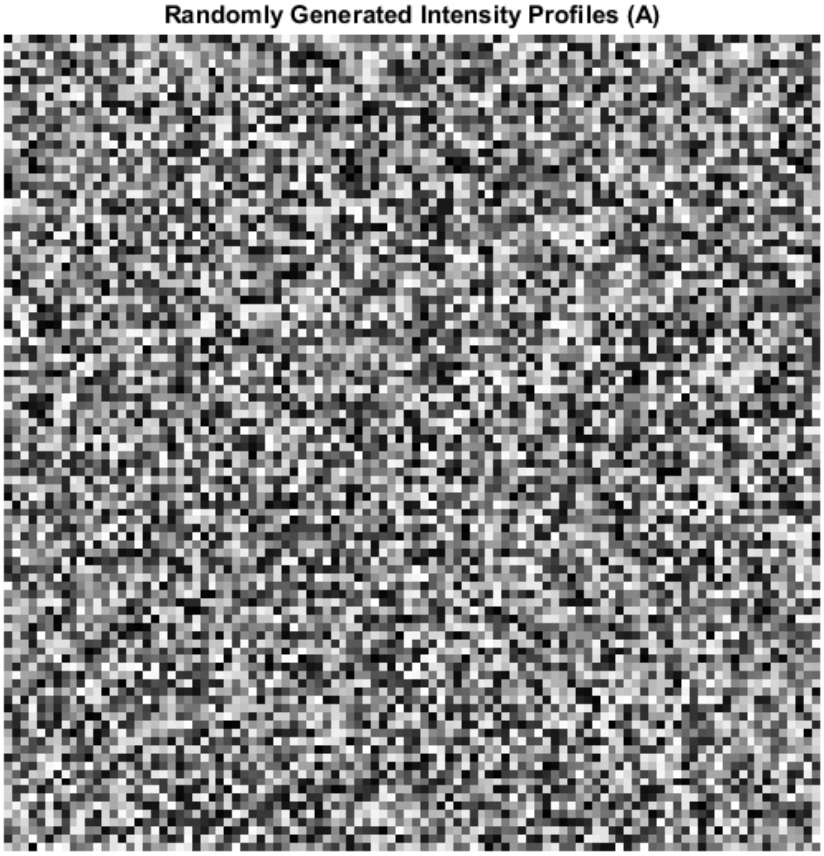
```
1 function result = diceTrials(n)
2     if(n>0)
3         result = uint8(rand([1,n])*5)+1;
4     else
5         result = 'You may wanna not to do
              that operation, the number of
              trials must be greater than 0';
6         error(result)
7 end
```

(b) (c) (d) (e) The contents of PS0_1-3.m file.

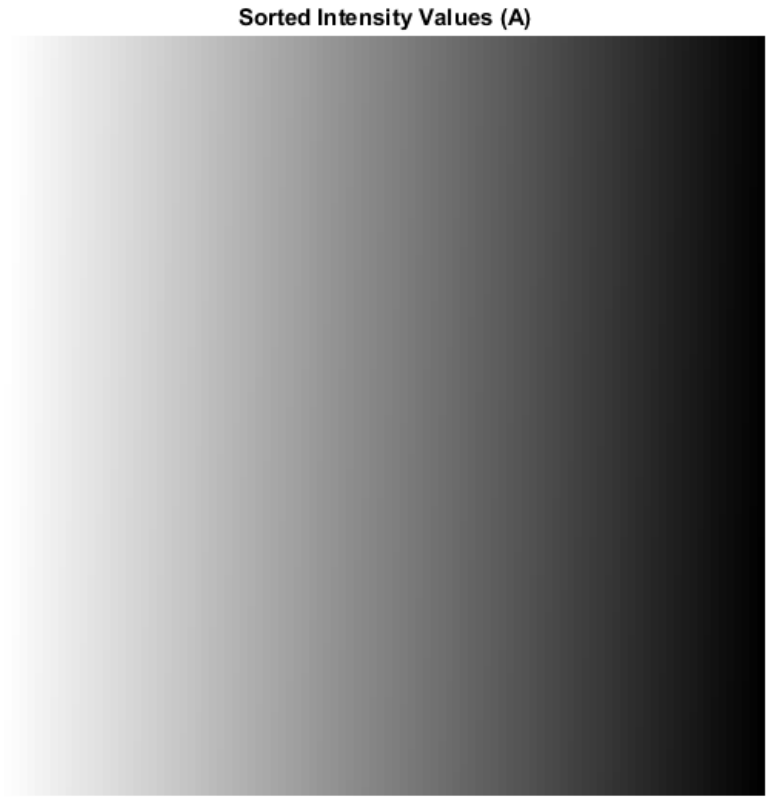
```
1 %% clear workspace, and command window,
     close all figures already open.
2 clear all, close all, clc;
3 %% PS0-1.3a
```

```
diceResults = diceTrials(99);
%% PS0-1.3b
% y = [1, 2, 3, 4, 5, 6]'
y = (1:6)';
% z = [1, 3, 5; 2, 4, 6]
z = reshape(y,[2,3]);
%% PS0-1.3c
% find the max value of matrice y and of
    which indice
[x, I] = max(y);
% convert indice to subscripts (row and
    column number)
[r, c] = ind2sub(size(z),I);
%% PS0-1.3d
% create vector v = [1, 8, 8, 2, 1, 3, 9,
    8]
v = [1,8,8,2,1,3,9,8];
% alter the value of vector x
% the problem can be solved by two
    different approach
% 1 - x = numel(v(v==1))
% 2 - x = sum(v==1)
x = numel(v(v==1));
```

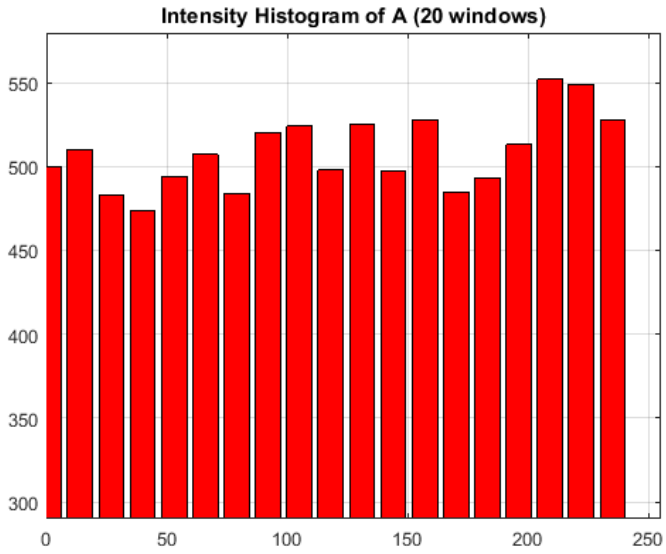
4. The code is in PS0Q1.m file.
   The source matrix created and used as input file is depicted below.



(a) Result of sort process.

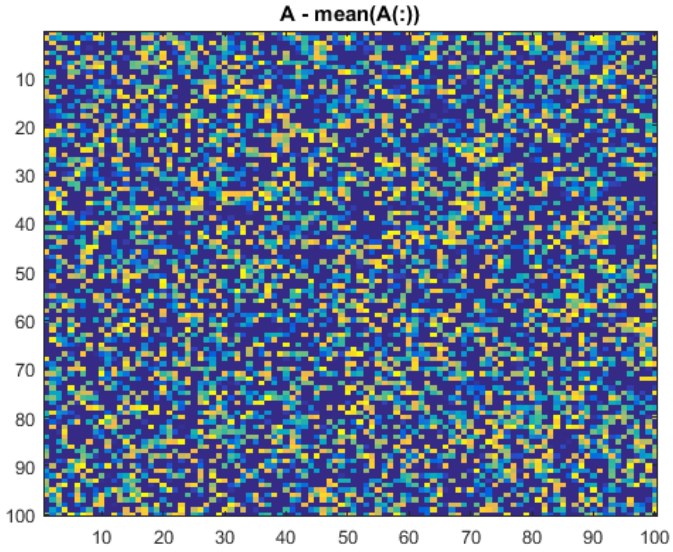


(b) Intensity histogram of A is given below.

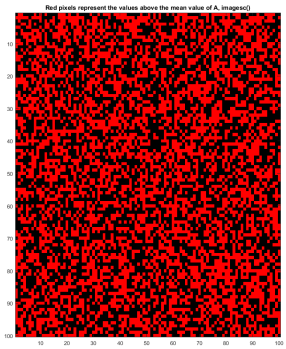


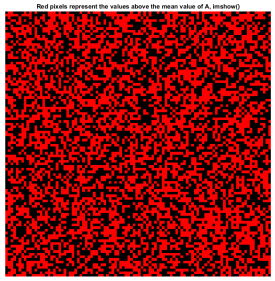
(c) The bottom left quadrant of A is depicted below. Please also find the attached outputXPS0Q1.mat in the zipped folder.

(d) Please find the attached outputYPS0Q1.mat file.



(e) Since the first matrix A is randomly created in *uint*8 data class $[0 - 255]$, pixels appear the same when the frame is displayed with imagesc() and imshow(). Hence, they both give the same output. Please find the attached outputYPS0Q1.mat file.





The contents of PS0Q1.m:

```
%% clear workspace , and command window,
    close all figures already open.
clear all, close all, clc;
```

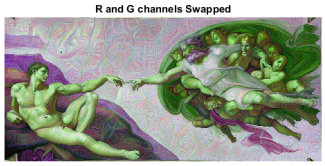
```
figure(1);
A = uint8(randi(255,[100,100]));
figure(1);
imshow(A);
title('Randomly Generated Intensity
    Profiles (A)')
save('inputAPS0Q1.mat', 'A');
load('inputAPS0Q1.mat', 'A');
%% PS-0 4a
A_sorted = sort(reshape(A,[numel(A), 1]),
    'descend');
A_sorted = reshape(A_sorted, size(A));
figure(2);
imshow(A_sorted);
title('Sorted Intensity Values (A)')
%% PS-0 4b
bins = 20;
maxA = max(A(:));
minA = min(A(:));
range = (maxA-minA)/bins;
hist = zeros(1,bins);
y = zeros(1,bins);
for i=1:20
    hist(i) = numel(A(A>=(minA+(i-1)*range
        ) & A<(minA+(i)*range)));
    y(i) = minA+(i-1)*range;
end
figure(3);
bar(y,hist, 0.8, 'r');
axis([0 255 min(hist) max(hist)*1.05])
grid on;
title('Intensity Histogram of A (20
    windows)');
%% PS-0 4c
% X = A_sorted(size(A,1)/2:size(A,1), 0:
    size(A,2)/2);
X = A(size(A,1)/2+1:size(A,1), 1:size(A,2)
    /2);
save('outputXPS0Q1.mat','X');
```

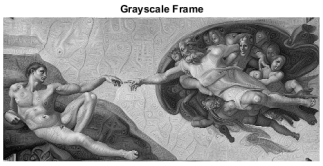
```
figure(4);
imagesc(X);
title('Bottom left quadrant of A');
%% PS-0 4d
Y = A - mean(A(:));
save('outputYPS0Q1.mat','Y');
figure(5);
imagesc(Y);
title('A - mean(A(:))');
%% PS-0 4e
Z = uint8(zeros(size(A_sorted,1),size(
    A_sorted,2),3));
ind = find(A>mean(A(:)));
[u, v] = ind2sub(size(A),ind);
for i=1:numel(ind)
    Z(u(i),v(i),:) = [255,0,0];
end
figure(6);
subplot(1,2,1), imagesc(Z); title('Red
    pixels represent the values above the
    mean value of A, imagesc()');
subplot(1,2,2), imshow(Z); title('Red
    pixels represent the values above the
    mean value of A, imshow()');
imwrite(Z, 'outputZPS0Q1.png');
```

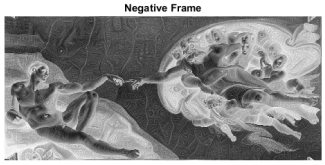
2 Short Programming Question

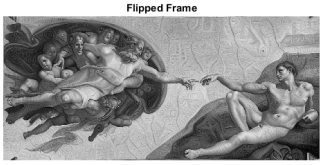
Input image:

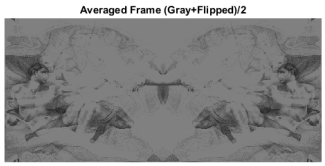
Results:

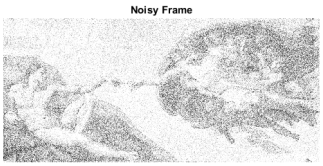












1. Swapped Image:

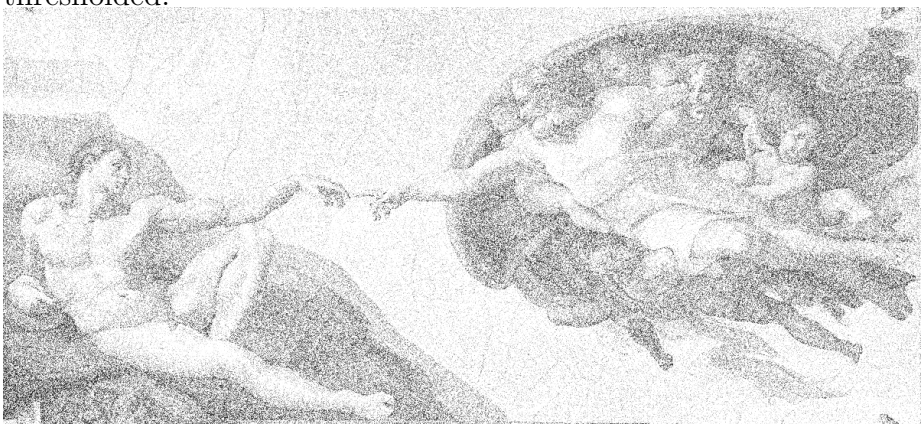
2. Grayscale Image:

3. (a) Negative Image:

(b) Flipped Image:

(c) Averaged Image:

(d) Because all the operations was completed with *uint*8 data class, any pixel going above 255 or below 0 automatically thresholded.



The contents of PS0Q2.m:

```
%% clear workspace , and command window,
   close all figures already open.
close all, clear all, clc;
%% read the RGB image and create figure
frame = imread('inputPS0Q2.jpg');
figure(1);
%% swap channels
% the problem can be solved by two different
   approach
% 1 - built-in permute function
% 2 - traditional channel swapping
R = frame(:,:,1);
G = frame(:,:,2);
B = frame(:,:,3);
frameSwapped(:,:,1) = G;
frameSwapped(:,:,2) = R;
frameSwapped(:,:,3) = B;
imwrite(frameSwapped, 'swapImgPS0Q2.png');
subplot(3,2,1), imshow(frameSwapped);
title('R and G channels Swapped');
%% Convert RGB frame to Grayscale
frameGray =  rgb2gray(frame);
imwrite(frameGray, 'grayImgPS0Q2.png');
subplot(3,2,2), imshow(frameGray);
title('Grayscale Frame');
% the problem can be solved by two different
   approach
% 1 - built-in imcomplement function
% 2 - exploiting Matlab data class features
frameNegative = 255-frameGray;
imwrite(frameNegative, 'negativeImgPS0Q2.png'
   );
subplot(3,2,3), imshow(frameNegative);
title('Negative Frame');
%% Flip the frame
frameFlipped = fliplr(frameGray);
imwrite(frameFlipped, 'mirrorImgPS0Q2.png');
```

```
34 subplot(3,2,4), imshow(frameFlipped);
35 title('Flipped Frame');
36 %% Average Gray Frame with Flipped
37 frameAverage = (frameGray+frameFlipped)/2;
38 imwrite(frameAverage, 'avgImgPS0Q2.png');
39 subplot(3,2,5), imshow(frameAverage);
40 title('Averaged Frame (Gray+Flipped)/2');
41 %% Add Noise
42 N = uint8(randi(255, size(frameGray)));
43 save('noise.mat', 'N');
44 frameClipped = frameGray+N;
45 imwrite(frameClipped, 'addNoiseImgPS0Q2.png')
       ;
46 subplot(3,2,6), imshow(frameClipped);
47 title('Noisy Frame');
```