

Image and Video Processing

Programming Assignment 3

Point Operations & Histogram Processing



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1 Question 1.

Read a colour image file, Extract the R G and B components of the image, and convert it to a grayscale image.

Read a color image

```
1 colourImage = imread('colourimage.jpg');
```

Extract the R, G, and B components

```
1 R = colourImage(:,:,1);
2 G = colourImage(:,:,2);
3 B = colourImage(:,:,3);
```

Convert to grayscale using the standard formula

```
1 grayImage = rgb2gray(colourImage);
```

Display results

```
1 figure;
2 subplot(2,2,1), imshow(colourImage), title('Original Color Image');
3 subplot(2,2,2), imshow(R), title('Red Channel');
4 subplot(2,2,3), imshow(G), title('Green Channel');
5 subplot(2,2,4), imshow(B), title('Blue Channel');
```

Original Color Image



Red Channel



Green Channel



Blue Channel



```
1 figure;
2 imshow(grayImage), title('Grayscale Image');
```



MATLAB R2024b - academic use

LIVE EDITOR

Current Folder

```

1 Read a color image
2 colourImage = imread("colourimage.jpg");
3 Extract the R, G, and B components
4 R = colourImage(:,:,1);
5 G = colourImage(:,:,2);
6 B = colourImage(:,:,3);
7 Convert to grayscale using the standard formula
8 grayImage = rgb2gray(colourImage);
9 Display results
10 figure;
11 subplot(2,2,1), imshow(colourImage), title('Original Color Image');
12 subplot(2,2,2), imshow(R), title('Red Channel');
13 subplot(2,2,3), imshow(G), title('Green Channel');
14 subplot(2,2,4), imshow(B), title('Blue Channel');
15 figure;
16 imshow(grayImage);

```

Original Color Image Red Channel
Green Channel Blue Channel

Width: 1,500 Height: 1,001

assignment3colourgray.mlx run complete 1 output created

Zoom: 100% UTF-8 LF script

Ln 12 Col 19

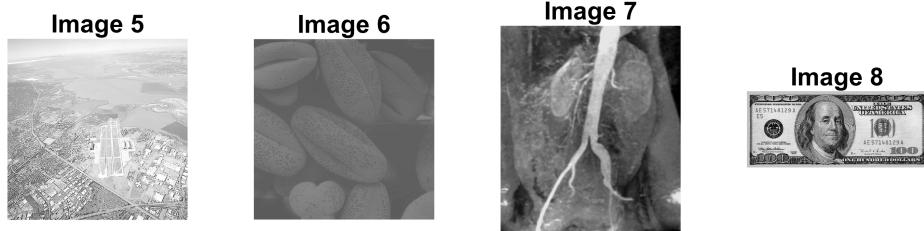
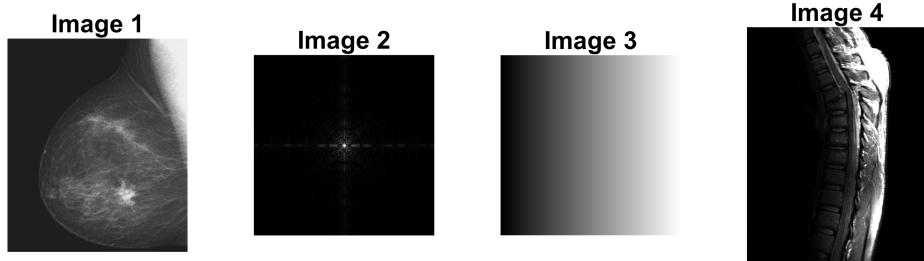
Figure 1: Matlab simulation: Output

2 Question 2.

Perform the point operations - image negative, thresholding, contrast stretching, grey level slicing, power law transformation, and bit-plane slicing. (Use the values of parameters as discussed in the class/presentation).

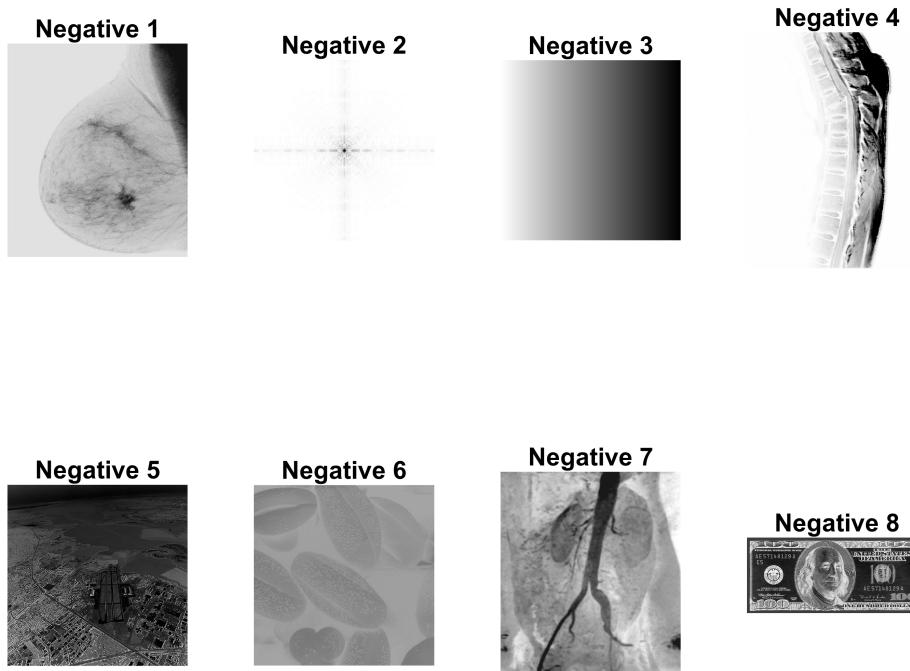
List of image filenames

```
1 image_files = { 'Fig0304(a)(breast_digital_Xray).tif', ...
2     'Fig0305(a)(DFT_no_log).tif', ...
3     'Fig0307(a)(intensity_ramp).tif', ...
4     'Fig0308(a)(fractured_spine).tif', ...
5     'Fig0309(a)(washed_out_aerial_image).tif', ...
6     'Fig0310(b)(washed_out_pollen_image).tif', ...
7     'Fig0312(a)(kidney).tif', ...
8     'Fig0314(a)(100-dollars).tif' };
9
10 output_folder = 'processed_images';
11
12 if ~exist(output_folder, 'dir')
13     mkdir(output_folder);
14 end
15
16 figure('Name', 'Original Images (2x4 Grid)', 'NumberTitle', 'off');
17
18 for i = 1:length(image_files)
19     img = imread(image_files{i});
20
21     % Convert to grayscale if RGB
22     if size(img, 3) == 3
23         img = rgb2gray(img);
24     end
25
26     % Display image in 2x4 grid
27     subplot(2, 4, i);
28     imshow(img);
29     title(['Image ', num2str(i)]);
30 end
```



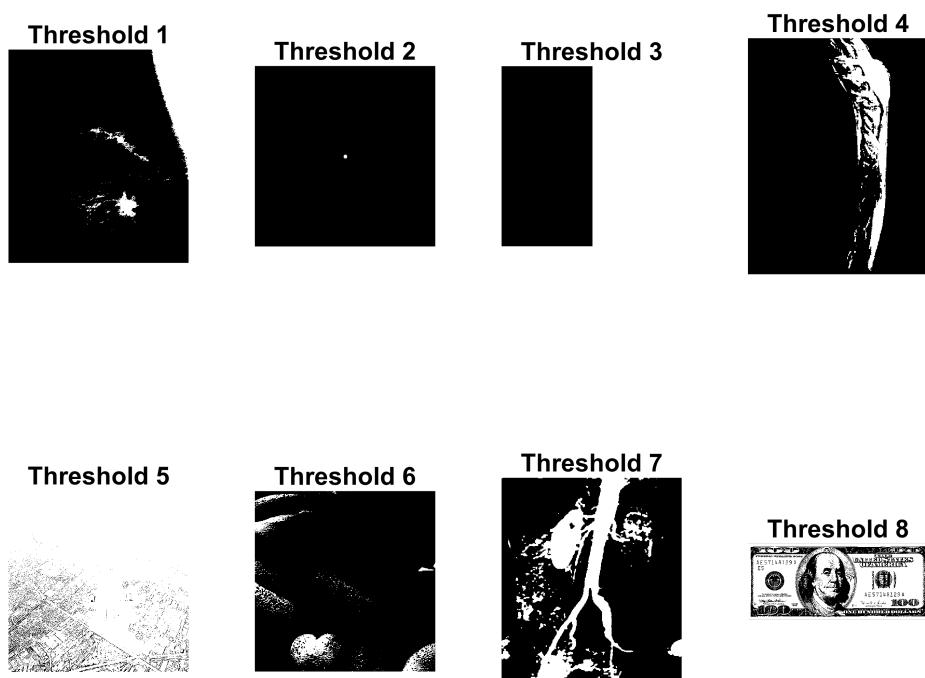
2.1 Image Negative

```
1 figure('Name', 'Image Negative', 'NumberTitle', 'off');
2 for i = 1:length(image_files)
3     img = imread(image_files{i});
4     if size(img, 3) == 3
5         img = rgb2gray(img);
6     end
7     img_negative = 255 - img;
8
9     imwrite(img_negative, fullfile(output_folder, ['negative_' image_files{i}]));
10
11    subplot(2,4,i); imshow(img_negative);
12    title(['Negative ' num2str(i)]);
13 end
```



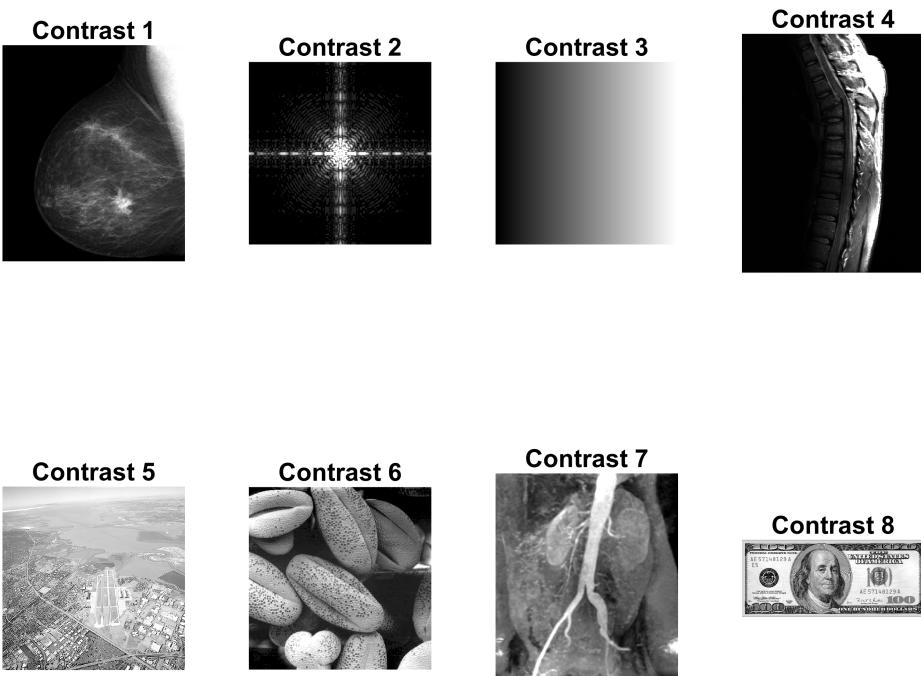
2.2 Thresholding

```
1 threshold = 128;
2 figure('Name', 'Thresholding', 'NumberTitle', 'off');
3 for i = 1:length(image_files)
4     img = imread(image_files{i});
5     if size(img, 3) == 3
6         img = rgb2gray(img);
7     end
8     img_threshold = img > threshold;
9
10    imwrite(img_threshold * 255, fullfile(output_folder, ['threshold_',
11                                         image_files{i}]));
12
13    subplot(2,4,i); imshow(img_threshold);
14    title(['Threshold ' num2str(i)]);
end
```



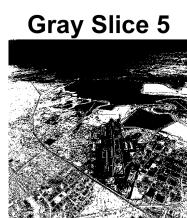
2.3 Contrast Stretching

```
1 figure('Name', 'Contrast Stretching', 'NumberTitle', 'off');
2 for i = 1:length(image_files)
3     img = imread(image_files{i});
4     if size(img, 3) == 3
5         img = rgb2gray(img);
6     end
7     img_stretched = imadjust(img, stretchlim(img), [0 1]);
8
9     imwrite(img_stretched, fullfile(output_folder, ['contrast_' image_files{i}]));
10
11    subplot(2,4,i); imshow(img_stretched);
12    title(['Contrast ' num2str(i)]);
13 end
```



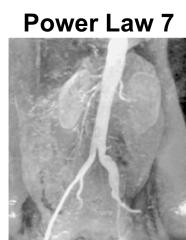
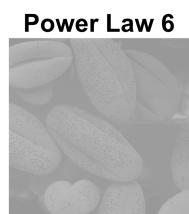
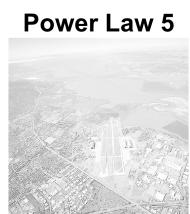
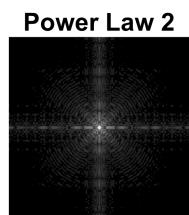
2.4 Gray Level Slicing

```
1 low = 100; high = 200;
2 figure('Name', 'Gray Level Slicing', 'NumberTitle', 'off');
3 for i = 1:length(image_files)
4     img = imread(image_files{i});
5     if size(img, 3) == 3
6         img = rgb2gray(img);
7     end
8     img_gray_slice = (img >= low & img <= high) * 255;
9
10    imwrite(img_gray_slice, fullfile(output_folder, ['gray_slice_' image_files{i}]));
11
12    subplot(2,4,i); imshow(img_gray_slice);
13    title(['Gray Slice ' num2str(i)]);
14 end
```



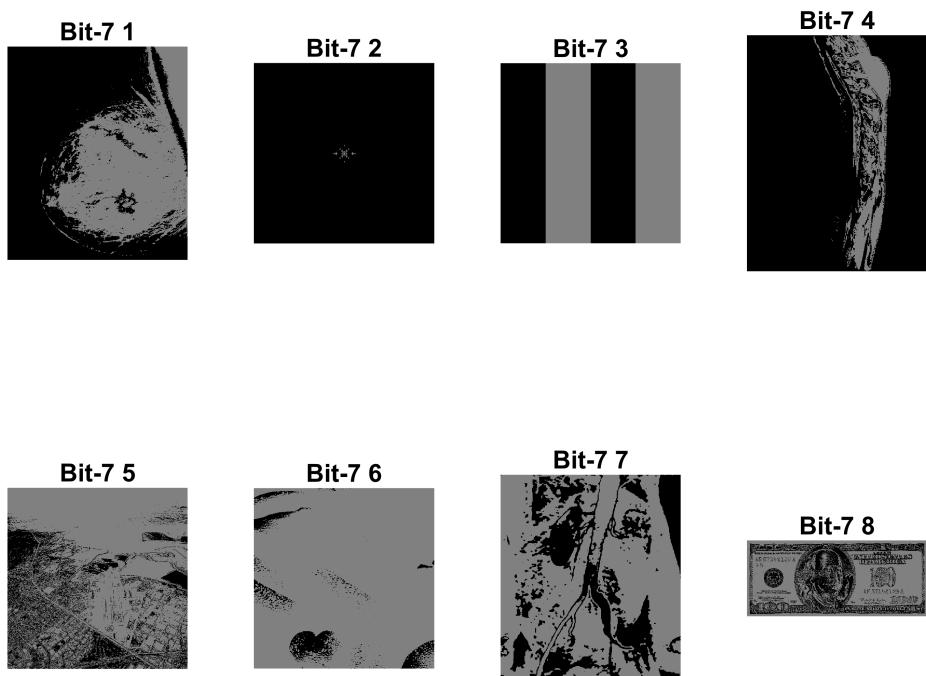
2.5 Power Law Transformation

```
1 gamma = 0.5;
2 figure('Name', 'Power Law Transformation', 'NumberTitle', 'off');
3 for i = 1:length(image_files)
4     img = imread(image_files{i});
5     if size(img, 3) == 3
6         img = rgb2gray(img);
7     end
8     img_power = im2double(img) .^ gamma;
9     img_power = uint8(255 * img_power);
10
11    imwrite(img_power, fullfile(output_folder, ['power_', image_files{i}]));
12
13    subplot(2,4,i); imshow(img_power);
14    title(['Power Law ' num2str(i)]);
15 end
```



2.6 Bit-Plane Slicing

```
1 figure('Name', 'Bit-Plane Slicing - Bit 7', 'NumberTitle', 'off');
2 for i = 1:length(image_files)
3     img = imread(image_files{i});
4     if size(img, 3) == 3
5         img = rgb2gray(img);
6     end
7     bit7 = bitget(img, 7) * 128;
8
9     imwrite(bit7, fullfile(output_folder, ['bit7_' image_files{i}]));
10
11    subplot(2,4,i); imshow(bit7);
12    title(['Bit-7 ' num2str(i)]);
13 end
```



2.7 Simulation screenshots

```

% MATLAB R2024b - academic use
% Live Editor - C:\Users\Nito\Documents\MATLAB\image and video processing assignment 3\assignment3b.m
% Current Folder
% Name
% processed_images
% assignment3b.m
% Fg0094a\breast_digital_Xray.tif
% Fg0095a\OFT_no_log.tif
% Fg0097a\intensity_ramp.tif
% Fg0098a\fractured_spine.tif
% Fg0099a\washed_out_serial_image.tif
% Fg0110a\washed_out_pollen_image.tif
% Fg0112a\sidney.tif
% Fg0114a\100-dollars.tif
% Fg0116a\top_left.tif
% Fg0116b\2nd_from_top.tif
% Fg0116c\3rd_from_top.tif
% Fg0116d\bottom_left.tif

% List of image filenames
image_files = {'Fg0116a\top_left.tif','Fg0116b\2nd_from_top.tif','Fg0116c\3rd_from_top.tif','Fg0116d\bottom_left.tif',...
    'Fg0094a\breast_digital_Xray.tif','Fg0095a\OFT_no_log.tif','Fg0097a\intensity_ramp.tif','Fg0098a\fractured_spine.tif',...
    'Fg0099a\washed_out_serial_image.tif','Fg0110a\washed_out_pollen_image.tif','Fg0112a\sidney.tif','Fg0114a\100-dollars.tif',...
    'Fg0116a\top_left.tif','Fg0116b\2nd_from_top.tif','Fg0116c\3rd_from_top.tif','Fg0116d\bottom_left.tif'};

% Output folder
output_folder = 'processed_images';

% Check if output folder exists
if ~exist(output_folder, 'dir')
    mkdir(output_folder);
end

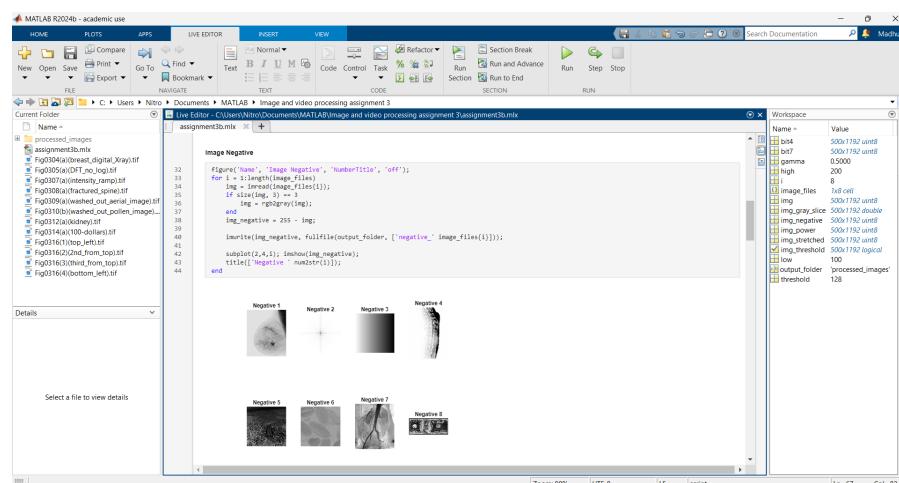
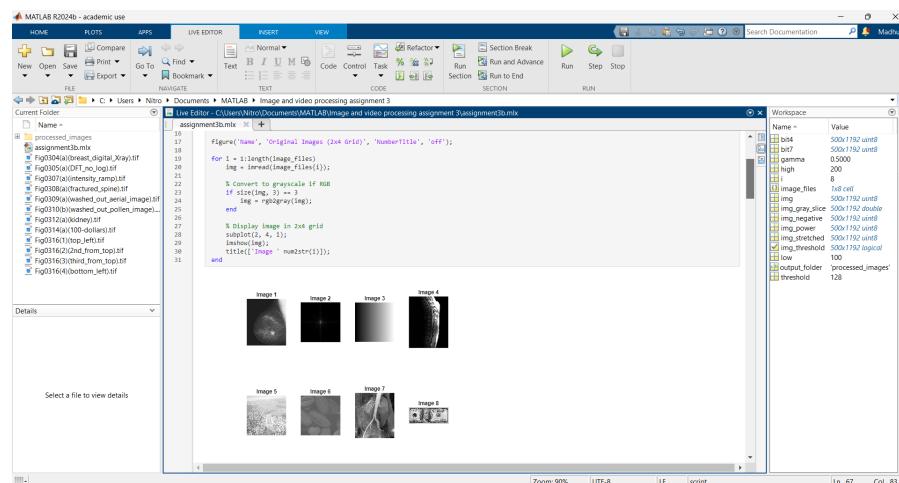
% Figure
figure('Name', 'Original Images (2x4 Grid)', 'NumberTitle', 'off');

for i = 1:length(image_files)
    img = imread(image_files{i});

    % Convert to grayscale if RGB
    if size(img, 3) == 3
        img = rgb2gray(img);
    end

    % Display image in 2x4 grid
    subplot(2, 4, i);
    imshow(img);
    title(['Image ' num2str(i)]);
end

```



MATLAB R2024b - academic use

Live Editor: C:\Users\Nitro\Documents\MATLAB\image and video processing assignment 3\assignment3.mlx

```

Current Folder
Name =
processed_images
assignment3.mlx
Fig0309(a)(threshold,Xray).tif
Fig0309(b)(OFT,mj_log).tif
Fig0309(a)(intensity,temp).tif
Fig0309(a)(fractured,spine).tif
Fig0309(a)(washed_out,serial_image).tif
Fig0314(a)(washed_out,serial_image).tif
Fig0312(a)(sidney).tif
Fig0314(a)(100-dollars).tif
Fig0314(1)(top_left).tif
Fig0314(1)(bottom_left).tif
Fig0314(3)(third_from_top).tif
Fig0314(4)(bottom_left).tif

Thresholding
threshold = 128;
figure('Name','Thresholding','NumberTitle','off');
for i = 1:length(image_files);
    img = imread(image_files{i});
    img = im2bw(img);
    img = im2uint8(img);
    img_threshold = img > threshold;
    imwrite(img_threshold, 255, fullfile(output_folder, ['threshold_' image_files{i}]));
    subplot(2,4,i);
    imshow(img_threshold);
    title(['threshold' num2str(i)]);
end

```

Details

Select a file to view details

Threshold 1 Threshold 2 Threshold 3 Threshold 4

Threshold 5 Threshold 6 Threshold 7 Threshold 8

Zoom: 90% | UTF-8 | LF | script | Ln 67 Col 83

MATLAB R2024b - academic use

Live Editor: C:\Users\Nitro\Documents\MATLAB\image and video processing assignment 3\assignment3.mlx

```

Current Folder
Name =
processed_images
assignment3.mlx
Fig0309(a)(threshold,Xray).tif
Fig0309(b)(OFT,mj_log).tif
Fig0309(a)(intensity,temp).tif
Fig0309(a)(fractured,spine).tif
Fig0309(a)(washed_out,serial_image).tif
Fig0312(a)(sidney).tif
Fig0314(a)(100-dollars).tif
Fig0314(1)(top_left).tif
Fig0314(1)(bottom_left).tif
Fig0314(3)(third_from_top).tif
Fig0314(4)(bottom_left).tif

Contrast Stretching
figure('Name','Contrast Stretching','NumberTitle','off');
for i = 1:length(image_files);
    if size(img, 3) == 3
        img = im2gray(img);
    end
    img_stretched = imadjust([img stretchlim(img), [0 1]]);
    imwrite(img_stretched, fullfile(output_folder, ['contrast_' image_files{i}]));
    subplot(2,4,i);
    imshow(img_stretched);
    title(['contrast' num2str(i)]);
end

```

Details

Select a file to view details

Contrast 1 Contrast 2 Contrast 3 Contrast 4

Contrast 5 Contrast 6 Contrast 7 Contrast 8

Zoom: 90% | UTF-8 | LF | script | Ln 67 Col 83

MATLAB R2024b - academic use

Live Editor: C:\Users\Nitro\Documents\MATLAB\image and video processing assignment 3\assignment3.mlx

```

Current Folder
Name =
processed_images
assignment3.mlx
Fig0309(a)(threshold,Xray).tif
Fig0309(b)(OFT,mj_log).tif
Fig0309(a)(intensity,temp).tif
Fig0309(a)(fractured,spine).tif
Fig0309(a)(washed_out,serial_image).tif
Fig0312(a)(sidney).tif
Fig0314(a)(100-dollars).tif
Fig0314(1)(top_left).tif
Fig0314(1)(bottom_left).tif
Fig0314(3)(third_from_top).tif
Fig0314(4)(bottom_left).tif

Gray Level Slicing
low = 128; high = 200;
figure('Name','Gray Level Slicing','NumberTitle','off');
for i = 1:length(image_files);
    img = imread(image_files{i});
    img = im2uint8(img);
    if size(img, 3) == 3
        img = im2gray(img);
    end
    img_gray_slice = (img > low & img <= high) * 255;
    imwrite(img_gray_slice, fullfile(output_folder, ['gray_slice_' image_files{i}]));
    subplot(2,4,i);
    imshow(img_gray_slice);
    title(['gray slice' num2str(i)]);
end

```

Details

Select a file to view details

Gray Slice 1 Gray Slice 2 Gray Slice 3 Gray Slice 4

Gray Slice 5 Gray Slice 6 Gray Slice 7 Gray Slice 8

Zoom: 90% | UTF-8 | LF | script | Ln 67 Col 83

MATLAB R2024b - academic use

LIVE EDITOR

```

Current Folder
Documents > MATLAB > Image and video processing assignment 3>assignment3b.m
assignment3b.m < +
```

Power Law Transformation

```

gamma = 0.5;
for i = 1:length(image_files)
    img = imread(image_files(i));
    if size(img, 3) == 3
        img = rgb2gray(img);
    end
    img_power = im2double(img).^- gamma;
    img_power = uint8(255 * img_power);
    imwrite(img_power, fullfile(output_folder, ['power_' image_files(i)]));
end
```

Details

Select a file to view details

Power Law 1 Power Law 2 Power Law 3 Power Law 4

Power Law 5 Power Law 6 Power Law 7 Power Law 8

Zoom: 90% | UTF-8 | LF | script | Ln 67 Col 83

MATLAB R2024b - academic use

LIVE EDITOR

```

Current Folder
Documents > MATLAB > Image and video processing assignment 3>assignment3b.m
assignment3b.m < +
```

Bit-Plane Stacking

```

figure('Name', 'bit-plane_stacking - Bit 7', 'NumberTitle', 'off');
for i = 1:length(image_files)
    img = imread(image_files(i));
    if size(img, 3) == 3
        img = rgb2gray(img);
    end
    bit7 = im2uint8(img, 7) * 256;
    imwrite(bit7, fullfile(output_folder, ['bit7_' image_files(i)]));
end
```

Details

Select a file to view details

Bit 7 1 Bit 7 2 Bit 7 3 Bit 7 4

Bit 7 5 Bit 7 6 Bit 7 7 Bit 7 8

Zoom: 90% | UTF-8 | LF | script | Ln 67 Col 83

3 Question 3.

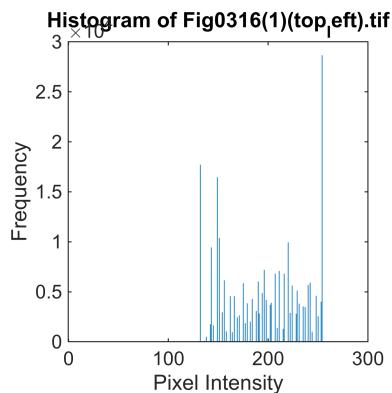
Compute the histogram of the given images without using the inbuilt function.

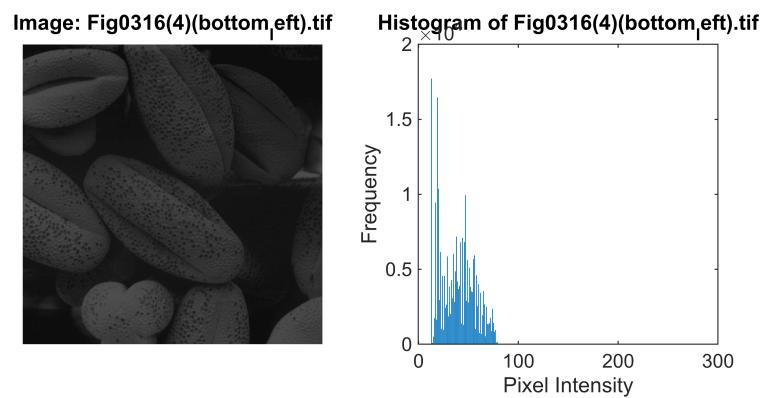
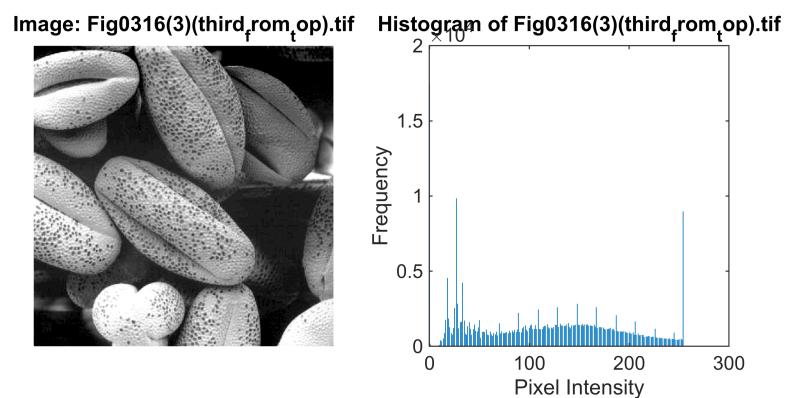
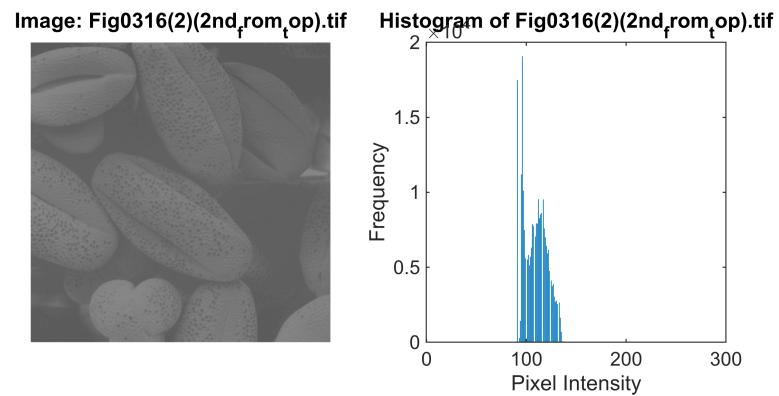
List of image filenames

```
1 image_filenames = {  
2     'Fig0316(1)(top_left).tif', 'Fig0316(2)(2nd_from_top).tif', ...  
3     'Fig0316(3)(third_from_top).tif', 'Fig0316(4)(bottom_left).tif'};
```

Histogram calculation

```
1 num_bins = 256;  
2  
3 for i = 1:length(image_filenames)  
4     img = imread(image_filenames{i});  
5  
6     hist = zeros(1, num_bins);  
7  
8     for row = 1:size(img, 1)  
9         for col = 1:size(img, 2)  
10            pixel_value = img(row, col);  
11            hist(pixel_value + 1) = hist(pixel_value + 1) + 1;  
12        end  
13    end  
14  
15    figure;  
16  
17    subplot(1, 2, 1);  
18    imshow(img);  
19    title(['Image: ', image_filenames{i}]);  
20  
21    subplot(1, 2, 2);  
22    bar(0:num_bins-1, hist);  
23    title(['Histogram of ', image_filenames{i}]);  
24    xlabel('Pixel Intensity');  
25    ylabel('Frequency');  
26  
27    axis square;  
28 end
```





3.1 Simulation screenshots

MATLAB R2024b - academic use

LIVE EDITOR

```

Current Folder
Name ~
assignment3b_media
assignment3c_media
processed_images
assignment3b.m
assignment3c.m
assignments3b.tex
assignments3c.tex
image_filenames
Fig0314(a)(break_digital_Xray).tif
Fig0314(a)(CFT_no_logit).tif
Fig0314(a)(intensity_ramp).tif
Fig0314(a)(washed_out_spine).tif
Fig0314(a)(washed_out_spine).tif
Fig0314(a)(washed_out_spine).tif
Fig0314(a)(washed_out_spine).tif
Fig0314(a)(100-dollars).tif
Fig0314(1)(top_left).tif
Fig0314(1)(top_left).tif
Fig0314(2)(2nd_from_top).tif
Fig0314(3)(third_from_top).tif
Fig0314(4)(bottom_left).tif

```

User Editor - C:\Users\Nitro\Documents\MATLAB\image and video processing assignment 3\assignment3c.m

```

assignment3b.m | assignment3c.m + [ ]

```

List of image filenames

```

1 image_filenames = [
2     'Fig0314(1)(top_left).tif', 'Fig0314(2)(2nd_from_top).tif',
3     'Fig0314(3)(third_from_top).tif', 'Fig0314(4)(bottom_left).tif'];

```

Histogram calculation

```

4 num_bins = 256;
5
6 for i = 1:length(image_filenames)
7     img = imread(image_filenames(i));
8
9     hist = zeros(1, num_bins);
10
11    for row = 1:size(img, 1)
12        for col = 1:size(img, 2)
13            pixel_value = img(row, col);
14            hist(pixel_value + 1) = hist(pixel_value + 1) + 1;
15        end
16    end
17
18    figure;
19
20    subplot(1, 2, 1);
21    imshow(img);
22    title(['Image: ', image_filenames(i)]);
23
24    subplot(1, 2, 2);
25    par(bins, num_bins - 1, hist);
26    xlabel('Pixel Intensity');
27    ylabel('Frequency');
28
29    axis square;
30
31 end

```

Figure:

Select a file to view details

Workspace

| Name | Value |
|-----------------|--------------------|
| b1d4 | 500x1192 uint8 |
| b1f7 | 500x1192 uint8 |
| col | 500 |
| gamma | 0.5000 |
| high | 200 |
| hist | 1x256 double |
| image_filenames | 7x4 cell |
| image_files | 7x1 cell |
| img | 500x500 uint8 |
| img_gray_slice | 500x1192 double |
| img_negative | 500x1192 uint8 |
| img_power | 500x1192 uint8 |
| img_processed | 500x1192 uint8 |
| img_threshold | 500x1192 logical |
| low | 100 |
| num_bins | 256 |
| output_folder | 'processed_images' |
| pixel_value | 49 |
| row | 500 |
| threshold | 1128 |

