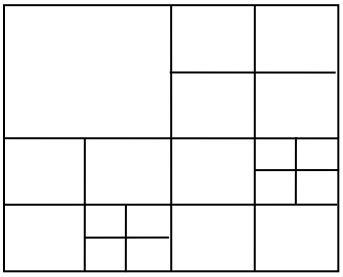
German University in Cairo
Faculty of Media Engineering and Technology
Winter 2019

DMET 901 – Computer Vision

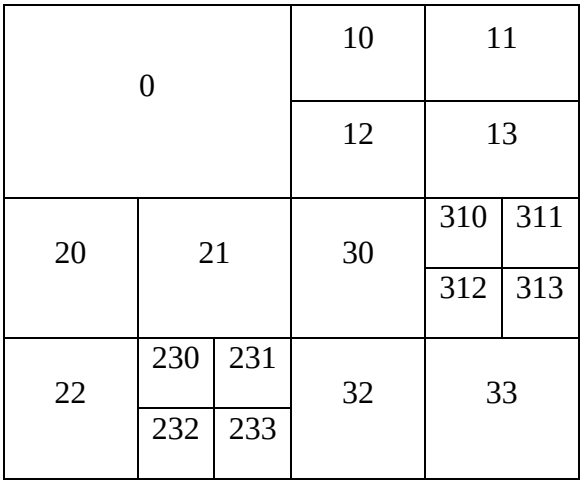
Problem Set #3 Solution

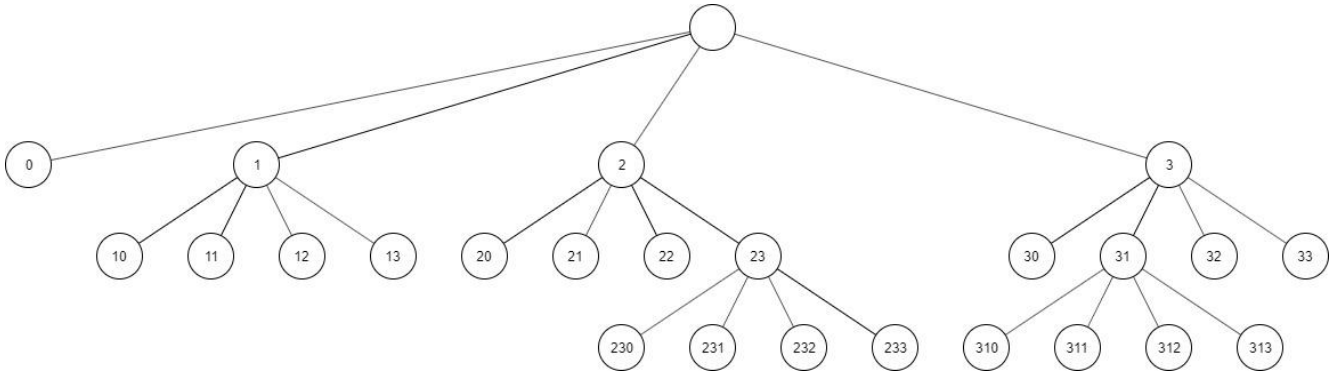
Problem 1

Find the quadtree that corresponds to the image given below. Each rectangle indicates a region whose all pixels have the same intensity. Assign an appropriate label to each region.



Image





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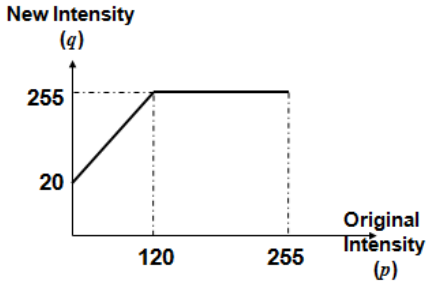
Problem 2

For the image shown below, what kind of effect would the given transformation do? Compute the intensity of the pixels after transformation.

0	10	10	5
130	140	150	5
2	120	50	60
0	200	255	30

Image



20	39	39	29
255	255	255	29
23	255	117	137
20	255	255	78

Output Image

Effect: leaner brightening for values between 0 till 120 to range between 20 till 255, saturation at 255 for values greater than 120, resulting in overall brightening.

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Problem 3

Consider the cameraman image:

Match each of the shown transformed versions of the above image to one of the transformations given below. State the **reason** for your choice.

Image A

Image B

Image C

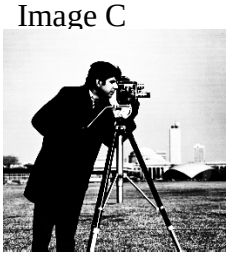
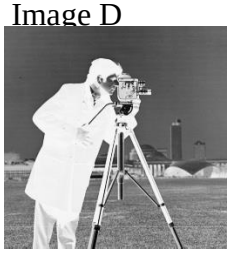
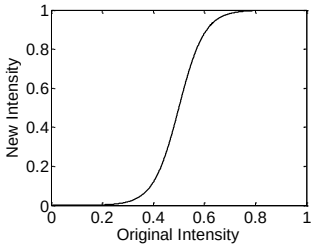


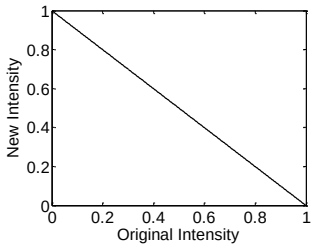
Image D



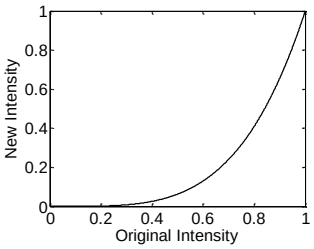
Transformation 1



Transformation 2



Transformation 3



Transformation 4

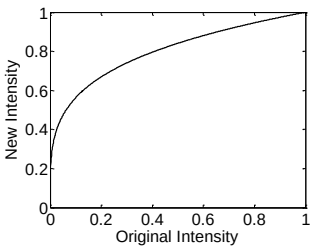


Image A: Transformation 3 as most intensities got darker.

Image B: Transformation 4 as most intensities got brighter.

Image C: Transformation 1 as contrast increased.

Image D: Transformation 2 as image in inverted.

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Problem Set #3 Solution

Problem 4

For the image shown below, apply an averaging filter of size 3 x 3 to the image.

0	5	10	5	1
3	10	8	20	2
6	4	7	30	5
0	200	10	20	1

Image

0	5	10	5	1
3	*5*	*11*	*9*	2
6	*26*	*34*	*11*	5
0	200	10	20	1

Output Image

Problem 5

For each of the following filters, explain how you expect applying the filter to an image would change the original image. Explain your reasoning.

a)
$$\begin{bmatrix} -1 & 0 & 1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$$

b)
$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

c)
$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0.25 & 0.25 \\ 0 & 0.25 & 0.25 \end{bmatrix}$$

a) Partial vertical edge detection.

b) No change.

c) Average filter (blur) using the lower right 2x2 kernel, introducing a bit of a shift.

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Problem Set #3 Solution

Problem 6

Given the following portion of an image and a Gaussian filter mask, show how the filter can be applied to the central pixel of the image.

75	100	50	0	0
100	150	100	50	0
150	200	150	100	50
200	250	200	150	50
225	250	250	200	100

Image

0.00	0.01	0.02	0.01	0.00
0.01	0.07	0.10	0.07	0.01
0.02	0.10	0.16	0.10	0.02
0.01	0.07	0.10	0.07	0.01
0.00	0.01	0.02	0.01	0.00

Gaussian Filter

The entries in the Gaussian filter add up to 1 – what is the significance of this? What is the effect of applying such filter?

$$F'(2,2) = (0 * 75) + (0.01 * 100) + (0.02 * 50) + (0.01 * 0) + (0 * 0) + (0.01 * 100) + (0.07 * 150) + (0.1 * 100) + (0.07 * 50) + (0.01 * 0) + (0.02 * 150) + (0.1 * 200) + (0.16 * 150) + (0.1 * 100) + (0.02 * 50) + (0.01 * 200) + (0.07 * 250) + (0.1 * 200) + (0.07 * 150) + (0.01 * 50) + (0 * 225) + (0.01 * 250) + (0.02 * 250) + (0.01 * 200) + (0 * 100) = 136$$

The significance of the values inside the kernel adding up to one is that both the input and the output ranges will remain the same, 0-255 in the case of images. The effect of the filter is blur.