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

DMET 901 – Computer Vision

Problem Set #1 Solution

Problem 1

Consider the 3 x 3 image given below. Show the result of zooming in the image to double its size (make it 6 x 6) if **nearest-neighbor interpolation** is used and if **bilinear interpolation** is used. Use any method you see appropriate for the right-most column and the bottom row in the zoomed images.

10	30	130
40	50	60
30	30	80

Original Image

Nearest Neighbor

10	10	30	30	130	130
10	10	30	30	130	130
40	40	50	50	60	60
40	40	50	50	60	60
30	30	30	30	80	80
30	30	30	30	80	80

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Problem Set #1 Solution

Bilinear Interpolation

Rows expanded step

10	20	30	80	130	130
40	45	50	55	60	60
30	30	30	55	80	80

Columns expanded step

10	20	30	80	130	130
25	32	40	67	95	95
40	45	50	55	60	60
35	37	40	55	70	70
30	30	30	55	80	80
30	30	30	55	80	80

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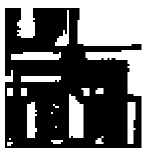
DMET 901 – Computer Vision

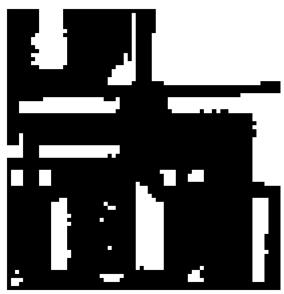
Problem Set #1 Solution

Problem 3

Consider the original image shown below and the two resized version of it (Resized A and Resized B). For each of the resized images, state whether it was resized using **nearest-neighbor interpolation** or **bilinear interpolation**. State the **reasons** for your choice.

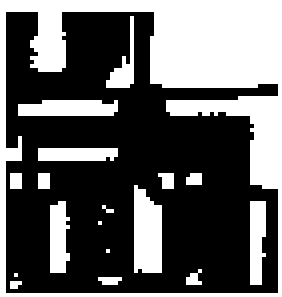


Original Image



Resized A

Resized B



Resized A

Resized B

A was resized using nearest neighbor interpolation and B using bilinear interpolation. Bilinear Interpolation uses average of the nearest pixels. Both nearest pixels influence the value of the output one. This means that the output value probably different than the nearest inputs, per example averaging between pure black and white pixels will result in gray value pixel and it results in a blurring effect.

DMET 901 – Computer Vision

Problem Set #1 Solution

Problem 4

Consider the 5 x 5 image given below and the new version of it

1	20	2	80
5	100	33	83
10	1	25	132
53	125	30	99
200	60	14	7

Original Image

5	25	30	75
8	120	33	83
19	1	50	120
53	125	21	93
200	55	25	12

Noisy Version of the Image

a) If the type of noise was additive, compute the Signal-to-Noise Ratio (SNR) defined as

$$SNR = \frac{\sum_{(x,y)} f^2(x,y)}{\sum_{(x,y)} v^2(x,y)}$$, where $f(x, y)$ denotes the original image and $v(x, y)$ denotes the noise

b) Repeat part a) if the type of noise was multiplicative.

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a) Additive noise

$$Noisy\ version = Original\ Image\ +\ Noise$$

$$Noise = Noisy\ version - Original$$

Noise matrix

4	5	8	-5
3	20	0	0
9	0	25	-12
0	0	-9	-6
0	-5	11	5

SNR = $\frac{115938}{1596}$ = 72.64

DMET 901 – Computer Vision

Problem Set #1 Solution

b) Multiplicative noise

$$Noisy\ version = Original * (\ 1 + Noise\ )$$
$$Noise = \frac{Noisy\ version}{Original} - 1$$

4	0.25	14	-0.06
0.6	0.2	0	0
0.9	0	1	-0.09
0	0	-0.3	-0.06
0	-0.08	0.78	0.71

SNR = $\frac{115938}{215.49}$ = 538.08

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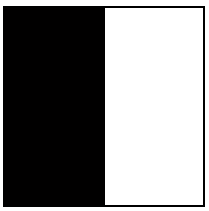
DMET 901 – Computer Vision

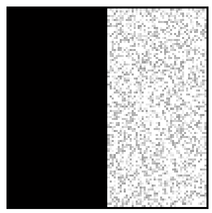
Problem Set #1 Solution

Problem 5

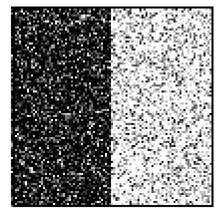
Consider the image given below and the two noisy versions of the image (Noisy Image A and Noisy Image B). For each of the noisy images, determine whether the type of noise is **Additive** or **Multiplicative**. **State** the reasons for your choice.



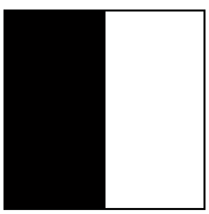
Original Image



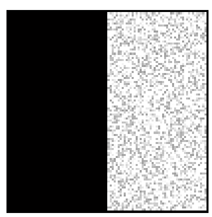
Noisy Image A



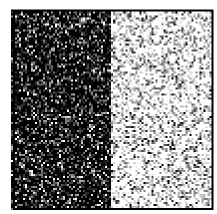
Noisy Image B



Original Image



Multiplicative



Additive

Reasons

From observing the noisy images, we can see that the black pixels in one of them didn't change and stayed black. Analyzing what happen to black pixels in each case, black pixels are always zero valued.

For the additive

$$Noise \;=\; Zero\;(\,black\;\,)+\;Noise$$

For the multiplicative

$$Zero\;\;=\;Zero\;(\,black\;\,)*(\,1+noise\,)$$