Lab 3 Report

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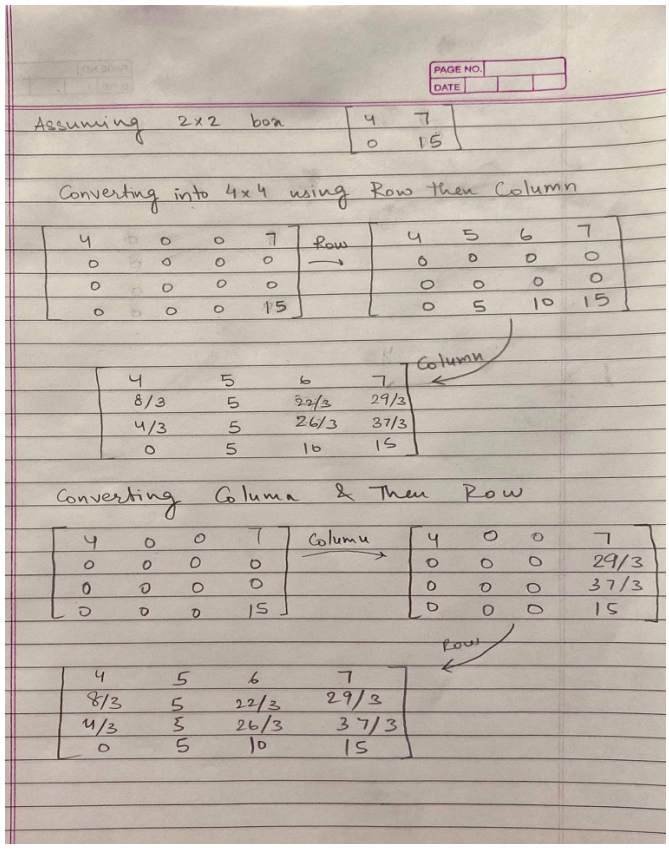
We are using interpolation algorithms to zoom into the image. We are also using decimation to decrease the size of the image without losing too much information. We are using this lab to display the problems associated with interpolation and decimation, namely making the image blurry and loosing information.

For the interpolation part of the lab, we initially used interpolation where we read the image and then pick a block of 128x128 pixels to zoom into. We then calculate the value of each of the pixels of the 512x512 image using the information from the128x128 image. we do the image interpolation of a specified 128x128 block and turn it into 512 x512 image. When we use Zero Order Hold algorithm, we simply replicate the each pixel value with the top left value of subblock to fill the corresponding 4x4 subblock in output image. In Bilinear interpolation algorithm, we also take the top left value of 4x4 subblock. But instead of replicate for each pixel with that value, we perform a computation of linear combination of neighboured copied pixels which make the output image much more smoother since it looks like it is increasing linearly. However, this also makes the image look a lot less sharp and makes it feel like it lost some information in the process, which it did. The order of doing the interpolation also doesn't matter so you can do it either way, row first and then column or column first then row. Which can be shown in the picture below.



As for the decimation part of the lab we read the image, then we decimate the image into a smaller sized image, then resize it and then find the difference between the original image and the resized image. And we use parameters and algorithms to check which one loses the least information. For the decimation we used decimation without an anti-aliasing filter and then one with aliasing filter. We also found both the images using different decimation factors. The result showed that when using the anti-aliasing filter in decimation we lose the sharpness of the image however, the image for most part looks normal as compared to decimation without an anti-aliasing filter, which makes the image lose some quality thus making it looks worse. As for the decimation factor, as the decimation factor increased the recovered image lost much more information.

The MSE of each method is as follows:
Method A: 802.178
Method B: 736.362
Method C: 3164.11
Method D: 2666.45

The images ranked from the best to the worst are as follows:

1. Method B with Decimation Factor = 2
2. Method A with Decimation Factor = 2
3. Method B with Decimation Factor = 8

4. Method A with Decimation Factor = 8

As subsampling rate increase, the MSE increases as well. Because the restore image from smaller image which is generated from larger subsampling rate will lose more information than those with smaller subsampling rate.

The anti-aliasing filter is used so that no aliasing occurs when we decimate the image and its done using the low pass filter. Therefore we lose information in the sharpness(high frequency) when we use anti-aliasing filter but we don't lose the information that makes the image look extremely different since removing the high frequency doesn't change the overall image whereas the aliasing would.

MSE is correlated with my subject evaluation. MSE compare the restored image with the original image and find the difference. The anti-aliasing low-pass filter perform better than non-anti-aliasing method.

The methods B and D are equivalent to convolving the input image with an "ideal interpolation" sinc function, then sub-sampling, both done in the spatial domain because the ideal low-pass filter in Fourier domain is a sinc function in the spatial domain so if we do interpolation on sinc that's the same as applying low-pass filter on the image.

The distortion in letters are more apparent than the distortion of cats when subsampling in Method A because we take a 2x2 subblock from original image. Letters forms its shape by combing the nearby pixels. The neighbours of pixel you copy to the smaller image may have huge difference with the copied pixel making the letters much less recognizable.

Comparing images obtained from method A and B, we can see that the main difference comes from the letters of the images. The letters in method A is as readable as compared to letters in method B, which look much better.

Overall, we found out that the bilinear interpolation have smoother blurring effect than zero order hold method and decimation with low-pass filter performs better than the method without anti-aliasing.