HACETTEPE UNIVERSITY
DEPARTMENT OF COMPUTER ENGINEERING
FUNDAMENTALS OF IMAGE PROCESSING LABORATORY
PROGRAMMING ASSIGNMENT 1
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PART 1

- **How is the given method achieved to prevent quantization error? Explain with examples.**

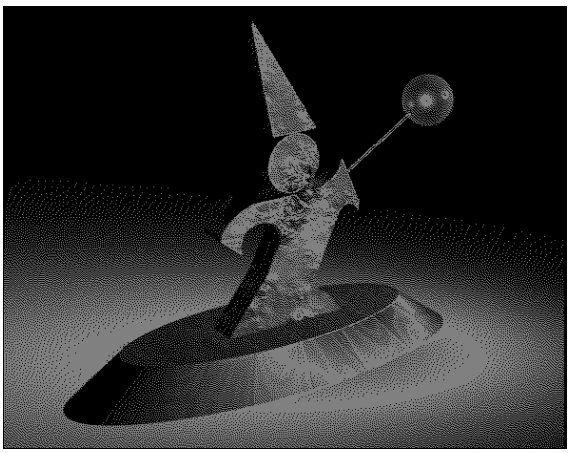
  The algorithm shifts the quantization error that occurs in the transformation to neighboring pixels in order to reduce the pixel losses that occur in quantization, to reduce the sharp transition between pixels and to obtain a quantized image that looks more like the real picture. Quantization error does this for a new pixel each time and does not process previously processed pixels. Thus, the pixel to be processed adjacent to it is more likely to be rounded up, resulting in a near-zero quantization error on average.

- **What is the behavior of the algorithm for different q parameters?**

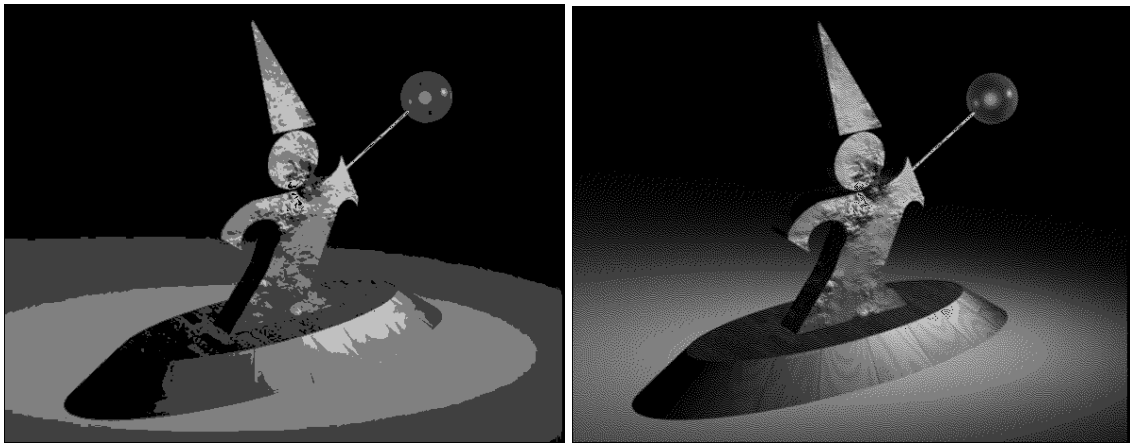
  The q parameter decides how much to quantize the image. For example, when we want to convert an 8-bit image to a 2-bit image, we must give q the value 64. The reason is this. An 8-bit gray photo has 256 different shades of gray than 2^8 =. When we want to convert our photo to a 2-bit image, when we put each pixel into the round(q * pixel) * q function, pixels in the 0-63 value range have the value 0, the pixels in the 64- 127 value range the 64 value, the 128-191 value range the 128 value, 192- Pixels in the value range of 255 will have the value of 192. As we can see, the values of all our pixels in an 8-bit photo would be converted to 0 and 64 and 128 and 192. These values can be represented in a 2-bit structure.

- **Compare the quantized image and dithered image for different q parameters.**

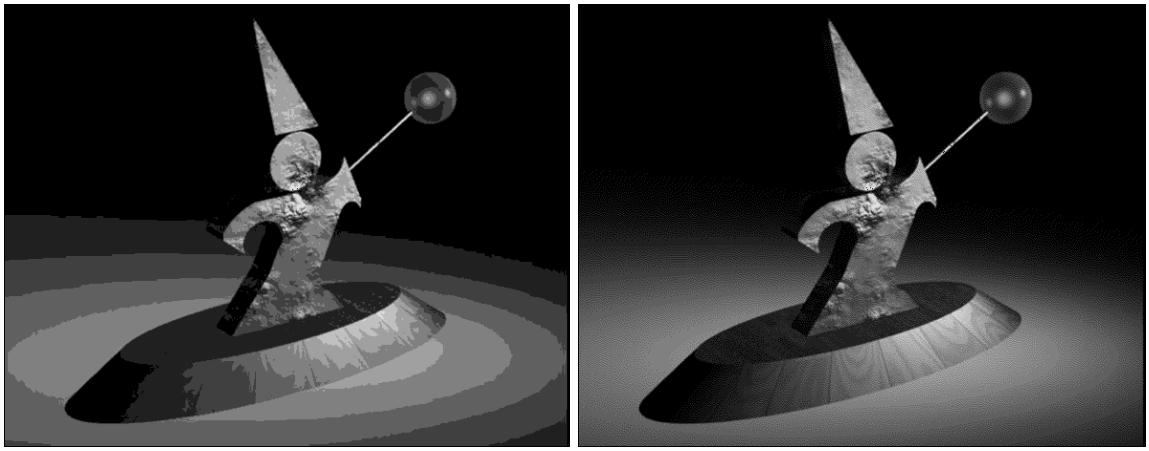
  q = 128 1-bit image (2 possible color values)



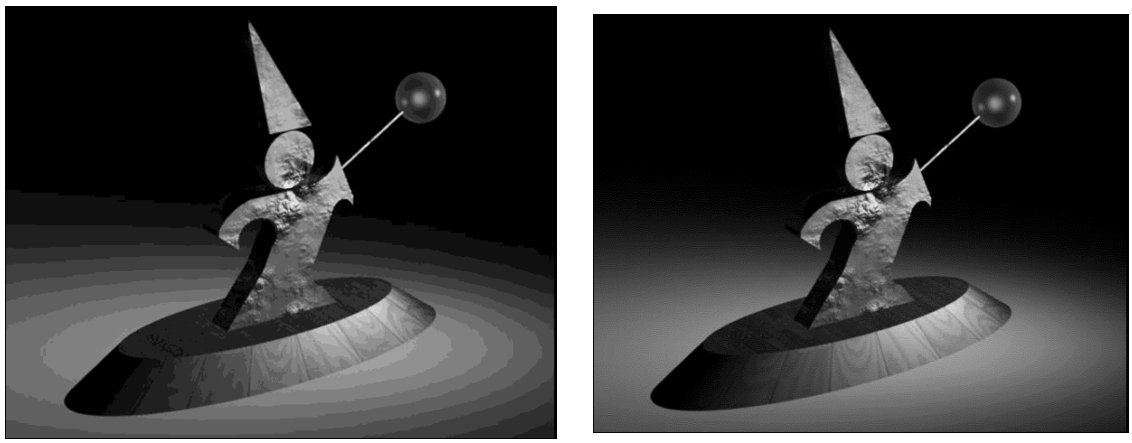
q=64 2-bit image (4 possible color values)



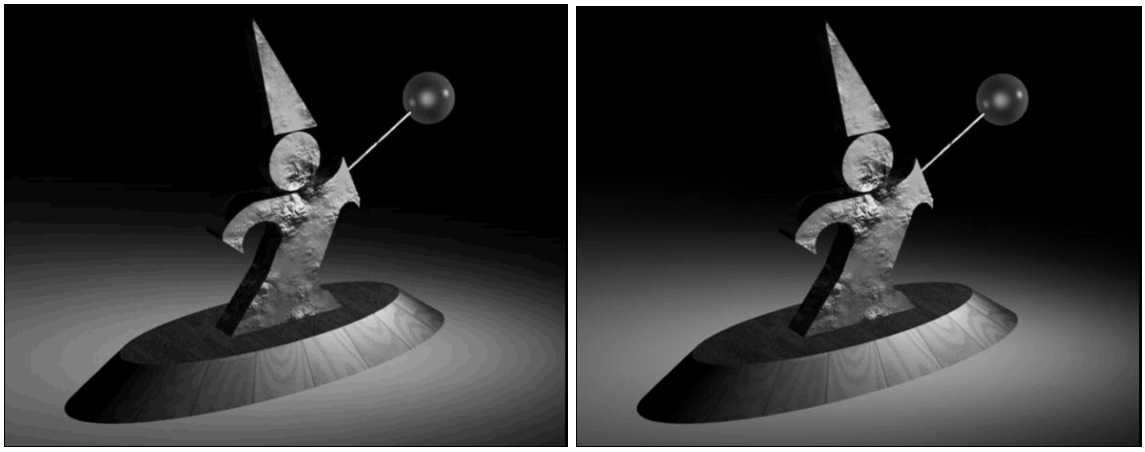
q = 32 3-bit image (8 possible color values)



q = 16 4-bit image (16 possible color values)



q = 8 5-bit image (32 possible color values)



- **What are the disadvantages of the Floyd-Steinberg dithering algorithm? Explain with examples.**

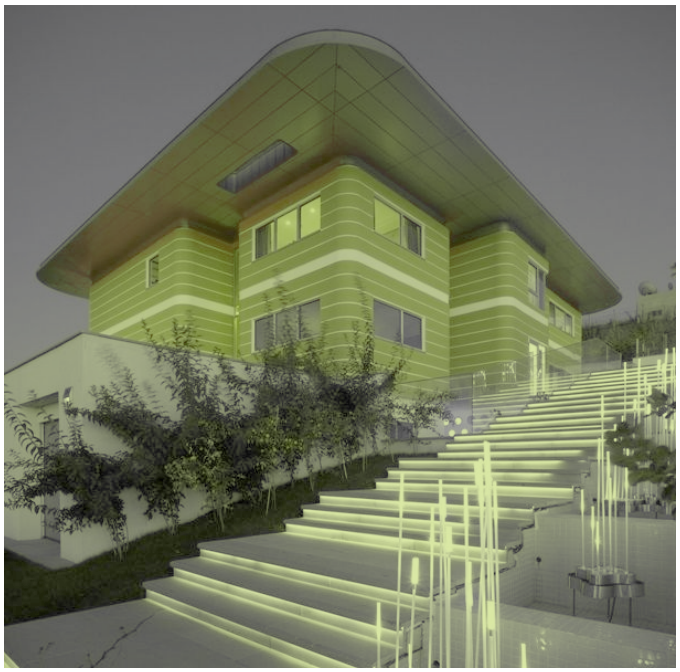
  Pixel values may exceed the valid range as a result of the pseudocode (such as greater than 255 in 8-bit greyscale images). Instead of clipping the intermediate values, such values should preferably be clipped using the find quantized value(oldpixel) function, as a subsequent mistake may put the value back into range. Wrapping intermediate values with fixed-width integers, on the other hand, causes inversion of black and white, and should be avoided.

  In addition, while navigating the data in the psude code, an error index_out_of_range is received when trying to reach the neighbors of the elements of the leftmost column, the lowest row and the rightmost row. To avoid this, these situations can be handled. Or, when the data in this situation is not processed, the quantization process will not be valid. Attention should be paid to this situation.

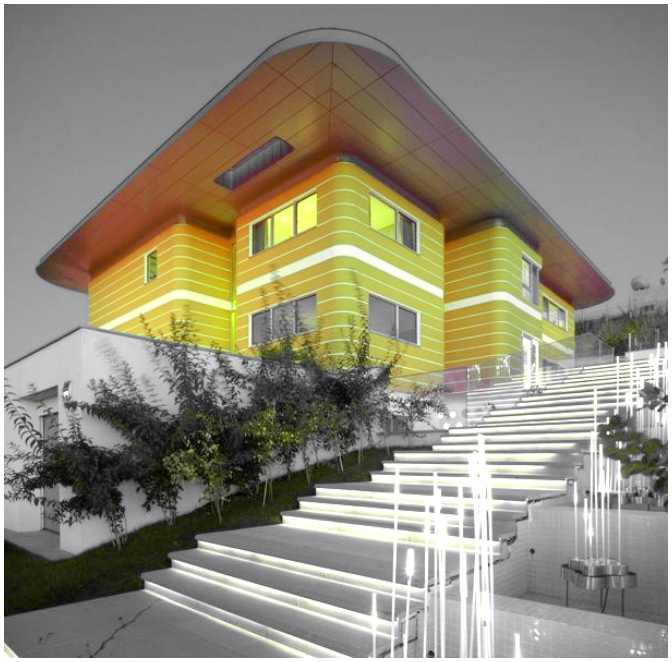
PART 2

- **Why does the algorithm change color space from RGB to Lab?**
  The LAB color space is particularly useful for boosting colors and definition in images due to the way it handles colors when compared to RGB. Rather than describing how colors should appear on a screen or in print, LAB is designed to approximate human vision. The LAB covers all potential colours, every colour that the human eye is able to see. When any image is converted to the LAB it will look exactly the same. TheLAB has a mix of one channel with no colour (L), plus two channels with a dual colour combination that have no contrast (a+b). . RGB operates on three channels: red, green and blue. The Lab is a conversion of the same information to a lightness component L*, and two color components - a* and b*. Lightness is kept separate from color, so that you can adjust one without affecting the other. "Lightness" is designed to approximate human vision, which is very sensitive to green but less to blue. If you brighten in Lab space, the result will often look more correct to the eye, color-wise. In general we can say that when using positive values for the saturation slider in Lab space, the colors come out more 'fresh', while using the same amount of saturation in RGB makes colors look 'warmer'.

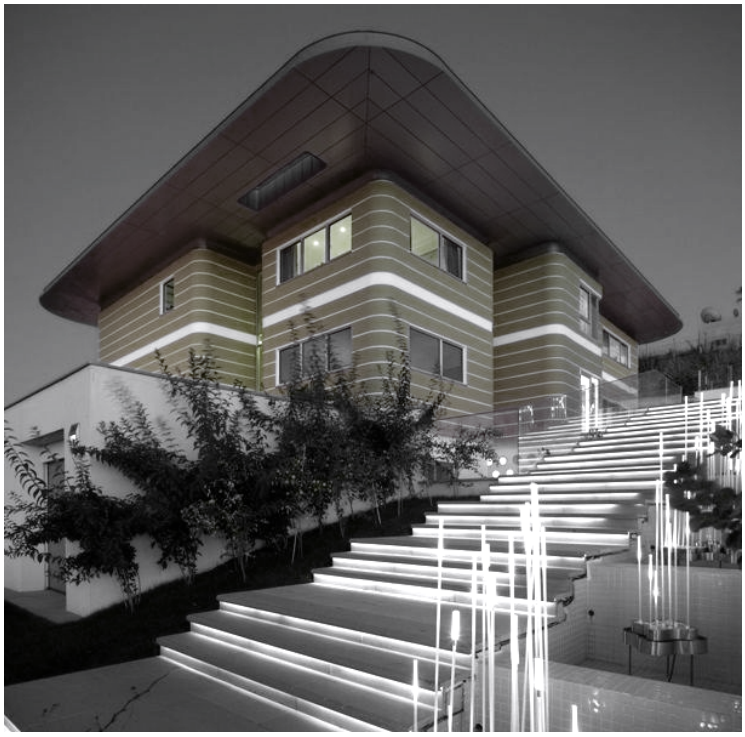
- **Show the results of your implementation for several images (you can use different images except the provided ones).**
  
  (Source Image 1)


(Target Image 1 ,Result Image1)


(Target Image2)


(Result Image2)


(Target Image3)

 (Result Image 3)

- **What are the disadvantages of the given color transfer algorithm? Show some failure results of the algorithm. Comment about the reasons.**

  Converting the data to logarithmic space and returning it back to linear space can sometimes distort the image. In addition, during conversions, the value of the data can go beyond 0-255 values for an 8-bit photo. It would be useful to do clipping that is not in the pseudocode. An example of a photo with and without logarithmic space transformation is as follows.


 (Source Image & Target Image)

(Result Images respectively logarithmic space conversation were applied and not)