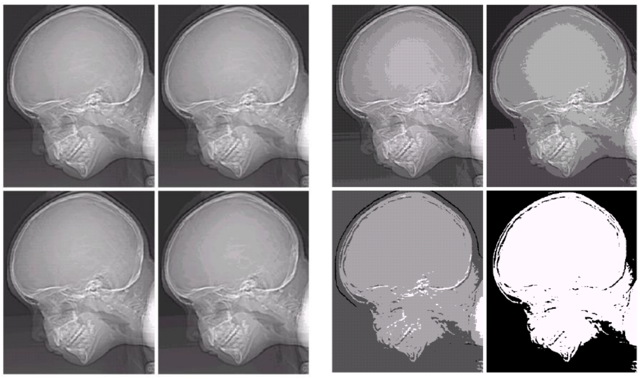
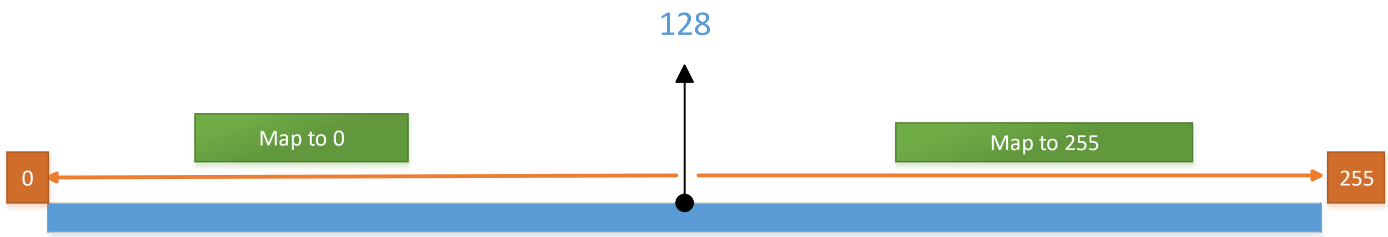
Digital Image Processing HW1 - Resolution

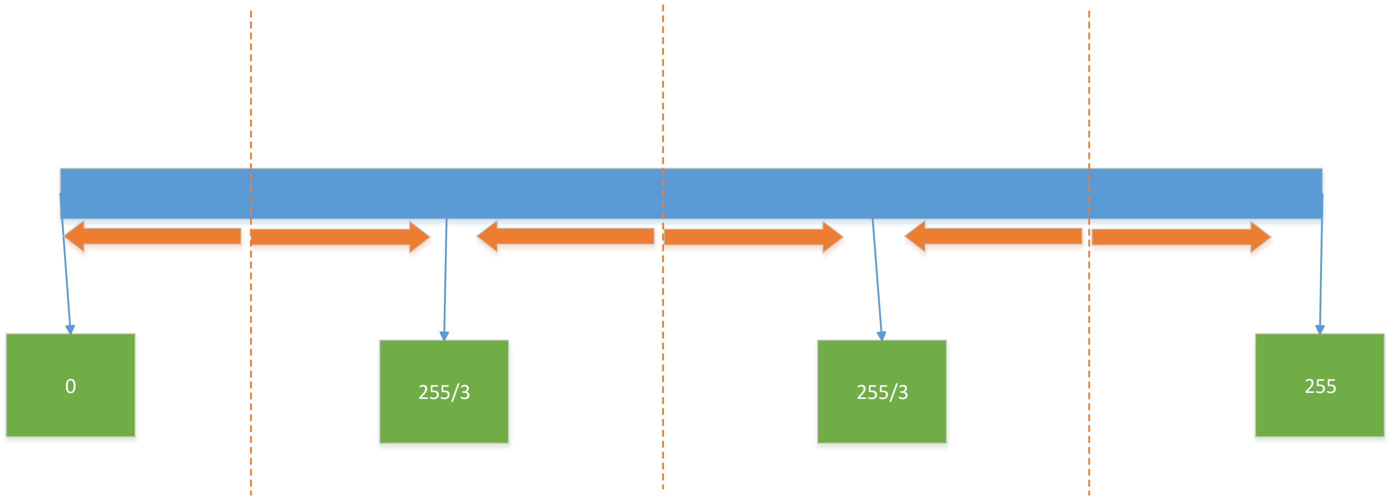

(Figure of Quantization Resolution in slides)

I use "**bit**" to understand Quantization Resolution. Originally, we have 8 bits (as known as 256 different value) to describe the value of each color. For example, if we apply a resolution of 128 levels, we would have only 7 bits to represent original value in 8 bits. Extremely, we would have two value (1 bit) to represent original value when we apply 2 level resolution. In this condition, all value exceed 128 will be **mapped to 255** and all value less than 128 will be **mapped to 0** after resolution. I start with this figure to finish this task.



For 2 level resolution, I use the formula: $x_{after} = round(x_{before}/255) \times 255$

Now, I need to generalize the formula to fit every case under 256 level resolution. Consider a more complex task: resolution with 4 level (2 bits), we have the following figure.



In this task, we could use this formula to find final value after resolution:

$$x_{after} = round\left(x_{before}/\frac{255}{3}\right) \times \frac{255}{3}$$

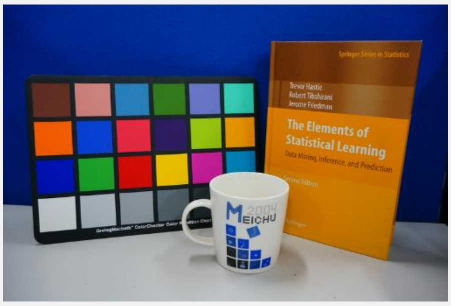
In previous formula, 255 is the difference of 0 and 255. In this formula, 255/3 is the difference of every 2 value after resolution (i.e. diff (0,255/3) or diff (255/3, 255)). This difference is named by "Step Size" and is defined by: $(\frac{255-0}{2^{bit\ number}-1})$. Therefore, when bit number = 1 (2 level), step size is 255. When bit number = 2

(4 level), step size is 255/3. Finally, we could generalize the formula to compute the value after resolution.

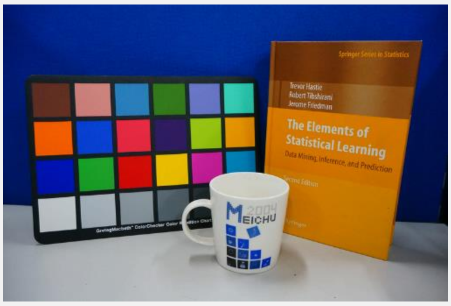
$$x_{after} = \ round\left(\frac{x_{before}}{step\ \ size}\right) \times step\ \ size\ \ \text{, where}\ \ step\ \ size = \ \left(\frac{255}{2^{bit\ \ number}-1}\right)$$

There are some result generated by my program:

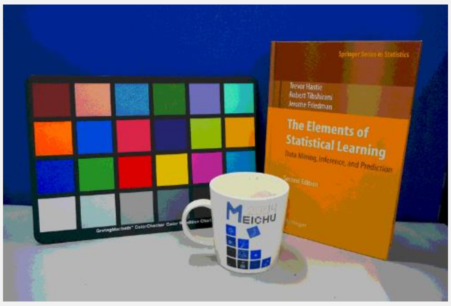
ORIGINAL IMAGE



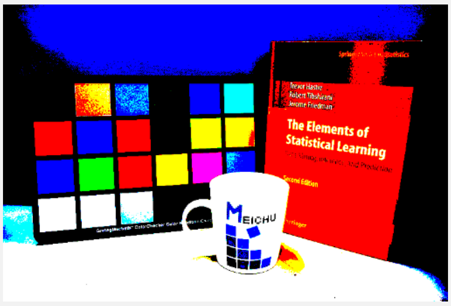
64 LEVEL RESOLUTION



8 LEVEL RESOLUTION



2 LEVEL RESOLUTION



Discussion

Start with **2 level resolution**, we could find the color in the image becomes **very monotonous**. When performing 2 level resolution on 24 bits per pixel image, the number of color in the result will be 2*2*2 = 8 (Red*Green*Blue). With the level of resolution increasing, the number of color in the image will be also increasing. For this input, there is **almost not different** between original image and 64 level resolution.