# Assignment C

## 1. The influence of different color space and $W_{rs}$ for self-regression model.

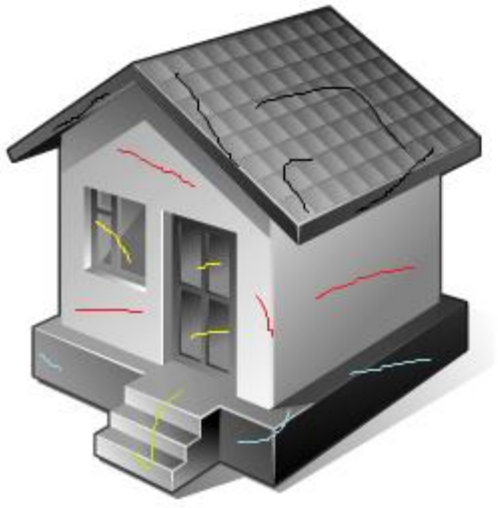

Figure 1: Marked Gray Image

### 1) Different color space

Figure 2: YIQ

Figure 3: Luv

Figure 4: Y$C_r C_b$

Figure 5: Lab

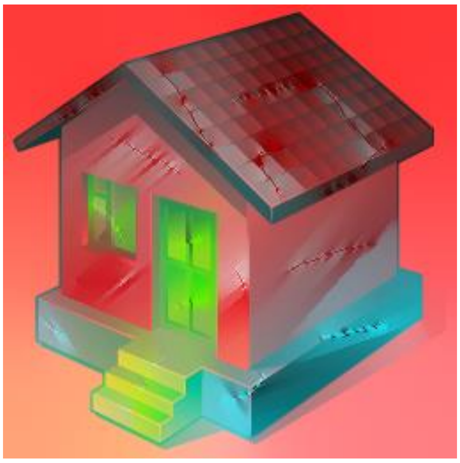

Figure 6: RGB

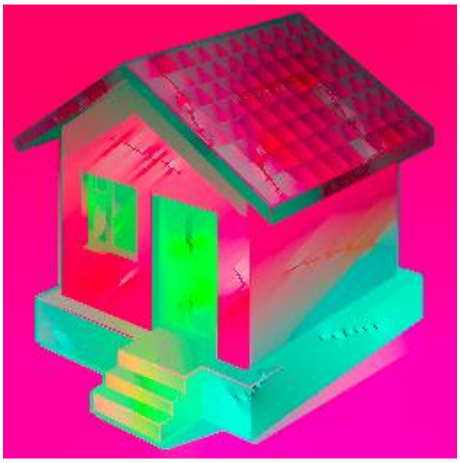

Figure 7: XYZ

**Analysis:**

YIQ: Generally good, but don't natural.

Luv: More sharpener than YIQ near the mark.

Y$C_r C_b$:More light and bright than the first two, but more natural.

Lab: More bleak than Y$C_r C_b$.

RGB: Obviously didn't do well in even coloring.

XYZ: Too light.

2) YIQ with different $W_{rs}$

Figure 8: $W_{rs}$ in algorithm

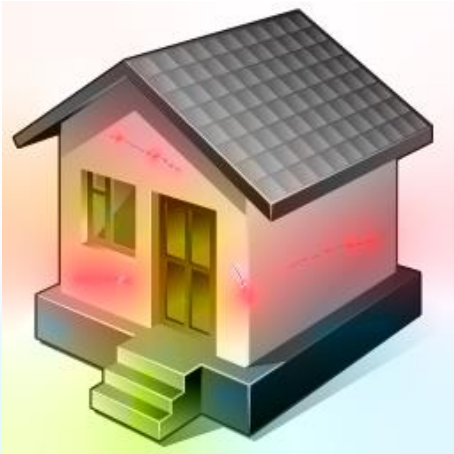

Figure 9: $W_{rs}$ taking an average

Figure 10: $W_{rs}$ taking random number

**Analysis:**

Different $W_{rs}$ will have a great influence on colorization. If we take an average for $W_{rs}$, the result is more bad than the origin one, so does random numbers.

## 2. The same color as different environment lead to different visual effects

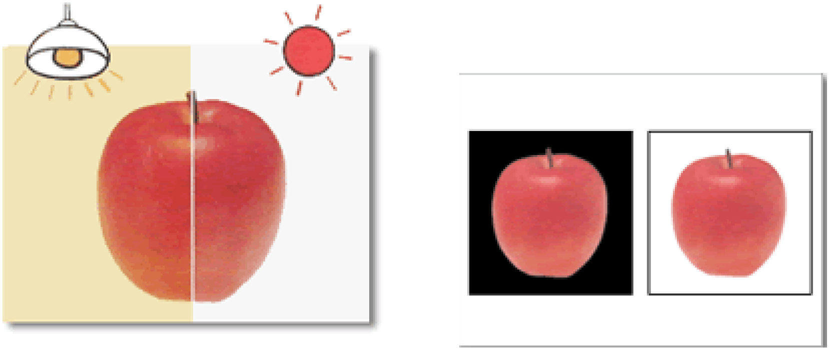

Figure 1 The same apple in different background

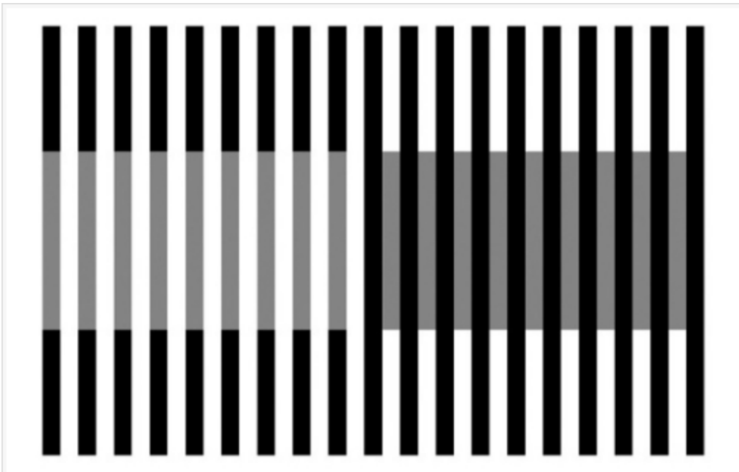

Figure 2 The same gray stripe show different brightnes


Figure 3 The same skirt show different color

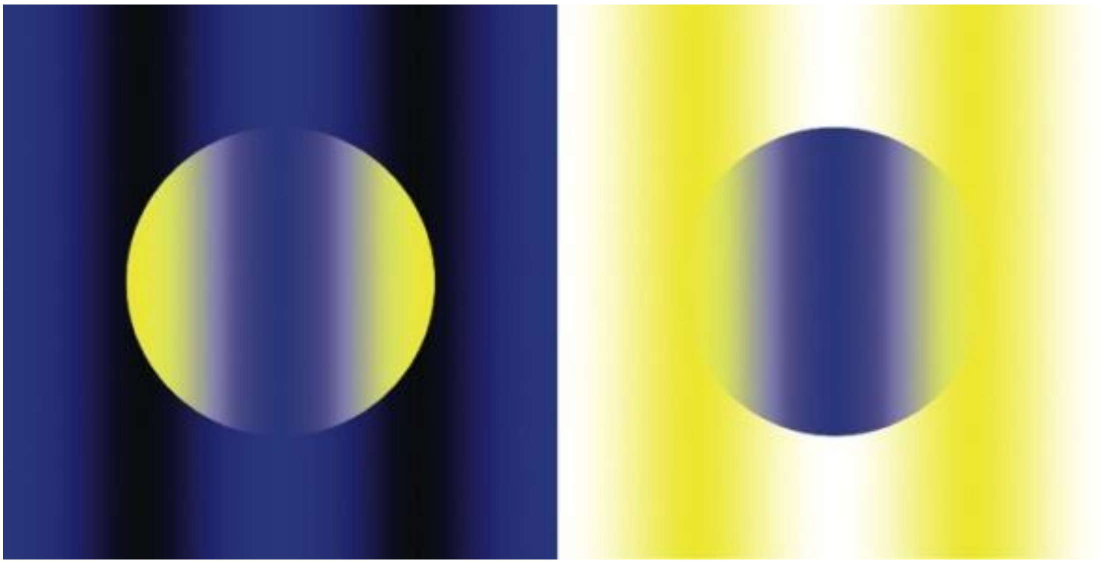

Figure 4 The same moon show different brightnss

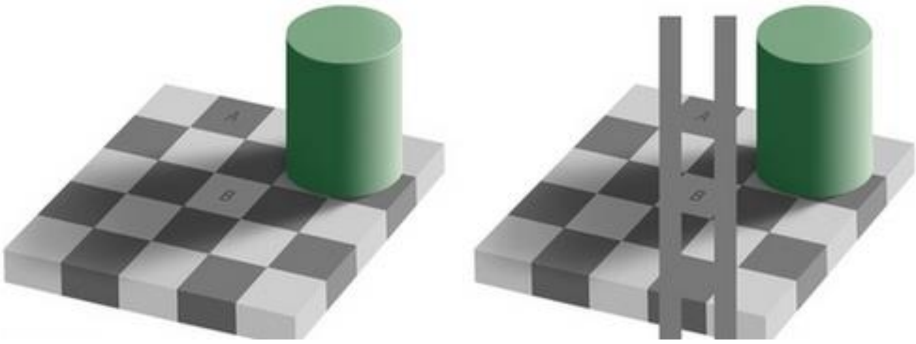

Figure 5 Block A and B are of the same color

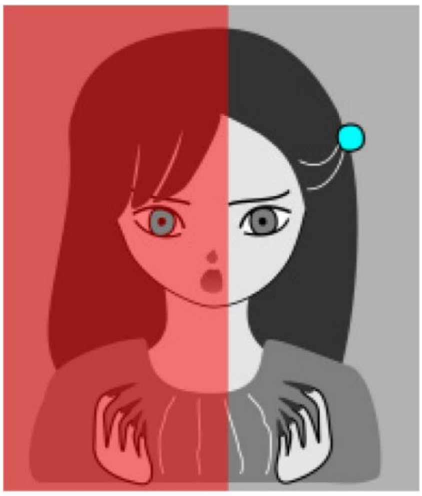


Figure 6 Two gray eyes look different

## 3. Deduction of matrix A

Self-regression model:

$$\mathrm{J(U)} = \sum_{r} \left[ U(r) - \sum_{s \in N(r)} W_{rs}\, U(s) \right]^2$$

Form which, for any pixel r, $\sum_{s \in N(r)} W_{rs}$=1, $W_{rs} \geq 0$.

To optimize the process of colorization, we have to let $\dfrac{\partial \mathrm{J(U)}}{\partial \mathrm{U(r)}} = 0.$

For any pixel k in an image,

a) When k is in the center of a pixel-neighborhood

$$\mathrm{J}_{k1}(\mathrm{U}) = \left[ U(k) - \sum_{s \in N(k)} W_{ks}\, U(s) \right]^2$$

After derivation,it is：

$$\frac{\partial\, \mathrm{J}_{k1}(\mathrm{U})}{\partial \mathrm{U(k)}} = 2U(k) - 2 \sum_{s \in N(k)} W_{ks}\, U(s)$$

b) When k is the neighborhood of pixel r

$$\mathrm{J}_{k2}(\mathrm{U}) = \sum_{r \in N(k)} \left[ U(r) - \sum_{\substack{s \in N(r) \\ s \neq k}} W_{rs}\, U(s) - W_{rk} U(k) \right]^2$$

The derivation process is as follows：

$$\frac{\partial\, \mathrm{J}_{k2}(\mathrm{U})}{\partial \mathrm{U(k)}} = \sum_{r \in N(k)} \left[ -2W_{rk} \left( U(r) - \sum_{\substack{s \in N(r) \\ s \neq k}} W_{rs}\, U(s) \right) + 2{W_{rk}}^2 U(k) \right]$$

$$= 2 \sum_{r \in N(k)} \left[ W_{rk} \left( -U(r) + \sum_{\substack{s \in N(r) \\ s \neq k}} W_{rs}\, U(s) \right) \right]$$

So the expression becomes:

$$\frac{\partial \mathrm{J(U)}}{\partial \mathrm{U(k)}} = \frac{\partial\ \mathrm{J}_{k1}(\mathrm{U})}{\partial \mathrm{U(k)}} + \frac{\partial\ \mathrm{J}_{k2}(\mathrm{U})}{\partial \mathrm{U(k)}} = 0$$

Does not contain an item, so it equals to the linear system AU= 0.

And from which we can get A.