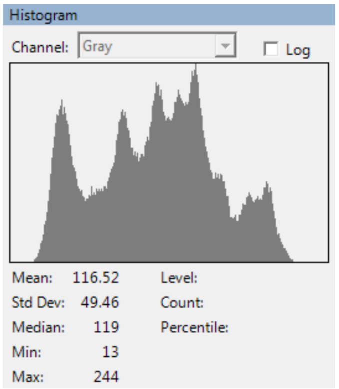
2021/02/23

Image processing -Point Operations

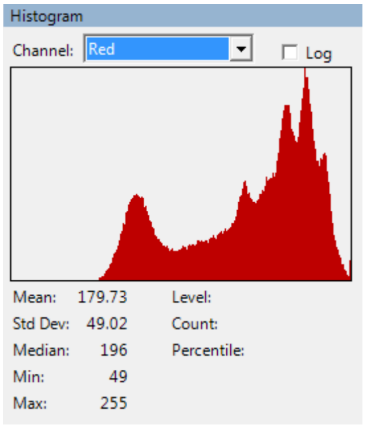
Histogram

It is distribution of colors in image



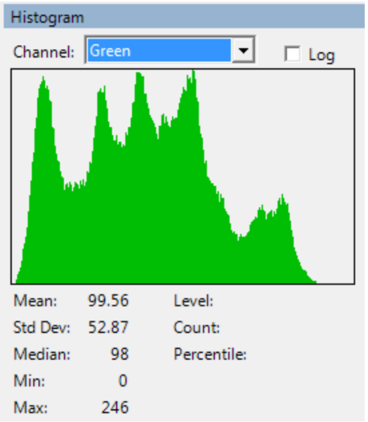
```
Histogram
Channel: Gray        ☐ Log

Mean:     116.52    Level:
Std Dev:   49.46    Count:
Median:      119    Percentile:
Min:          13
Max:         244
```



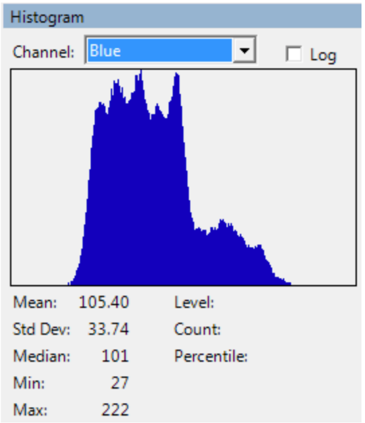
```
Histogram
Channel: Red         ☐ Log

Mean:     179.73    Level:
Std Dev:   49.02    Count:
Median:      196    Percentile:
Min:          49
Max:         255
```



```
Histogram
Channel: Green       ☐ Log

Mean:      99.56    Level:
Std Dev:   52.87    Count:
Median:       98    Percentile:
Min:           0
Max:         246
```



```
Histogram
Channel: Blue        ☐ Log

Mean:     105.40    Level:
Std Dev:   33.74    Count:
Median:      101    Percentile:
Min:          27
Max:         222
```

When looking at that histogram you can know:

- Darkness or lightness
- The most color of image is
- How similarity of two images

Color representations

RGB color model

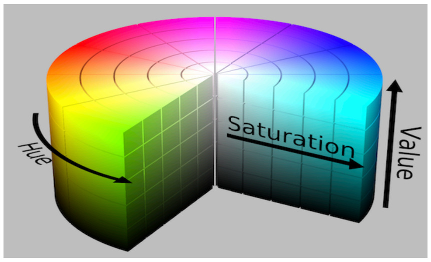
Mixing red, green, blue color to create a pixel color.
Red, green, blue light are added together in various way to reproduce a broad array of colors

HSV color model

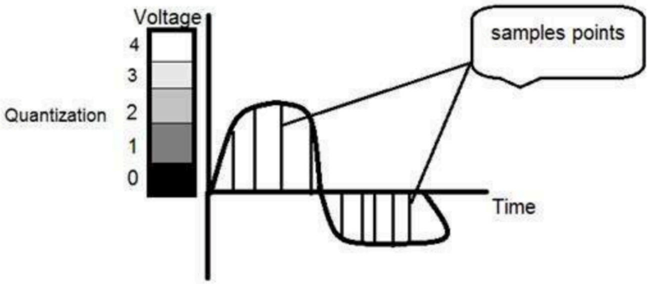
H: Hue. It is an array of color
S: Saturation it is mixing white color
V: Value (Brightness) it is mixing dark color

What if we change the value of S and V:

- S: the higher the less white color
- V: the higher the brighter



Sampling and quantization



The more samples you take, the more pixels, you get.
Quantization as the number of color – the range/level of value of a pixel

Compare images

Given:

- two images f & g,
- w & h are width and height.

The distance of two image can be calculated as following

Norm 1

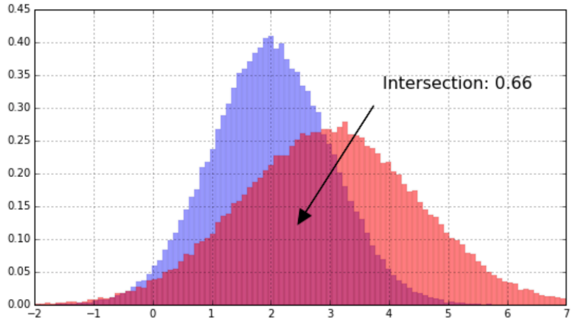
$$d(f,g) = \sum_{x=1}^{w} \sum_{y=1}^{h} |\, f(x,y) - g(x,y)|$$

Norm 2

$$d(f,g\,) = \sqrt{\sum_{x=1}^{w} \sum_{y=1}^{h} (f(x,y) - g(x,y))^2}$$

Compare base on histogram

$$d(H_1, H_2) = \sum_{i} \min(H_1[i], H_2[i])$$



Basic operations

Color Adjustments: Brightness

Given

- r, c is index of row and column
- g: the value needing to increasing

$$J(r,c,b) = \begin{cases} I(r,c,b) + g, \text{nếu } I(r,c,b) + g < 256 \\ 255 \qquad\qquad\quad , \text{nếu } \ I(r,c,b) + g > 255 \end{cases}$$

$$g \geq 0 \text{ và } b \ \in \{1, 2{,}3\} \text{ là các kênh màu}$$

Color Adjustments: contrast

Given C is the desired level of contrast [-255, +255]
The fist step is to calculate a constrast correction factor

$$F = \frac{259(C + 255)}{255(259 - C)}$$

The next step is to perform the actual contrast adjustment itself

$$R' = F(R - 128) + \ 128$$

Nearest color

The algorithm for reducing the number of color in an image

1. Start at the first pixel in the image
2. Get the actual color of the pixel
3. Find the nearest color of this pixel from the available palette
4. Replace the pixel with the nearest color
5. Have we reached the end of the image? If so stop here
6. Move on to the next pixel
7. Go back to step 2

The algorithm for finding finding nearest color: Using norm 2

1. Set minimum distance to a value higher than the highest possible
2. Start at the first color in the palette
3. Find the difference between each RGB value of the actual color and current palette color
4. Calculate the norm 2 distance
5. If the distance is smaller than the minimum distance set minimum distance to the smaller value and note the current palette color
6. Have you reached the end of the palette? If so stop here
7. Move on to the next color in the palette
8. Go back to step 3