Neural Style Transfer

Style cost function

deeplearning.ai

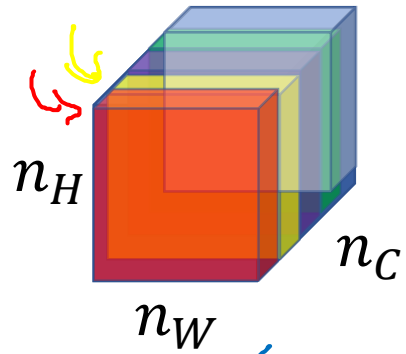# Meaning of the "style" of an image
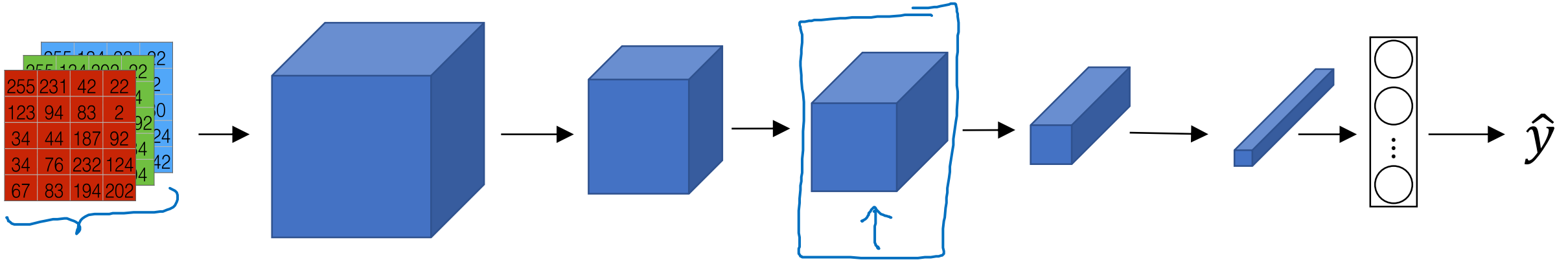
Say you are using layer l's activation to measure "style."
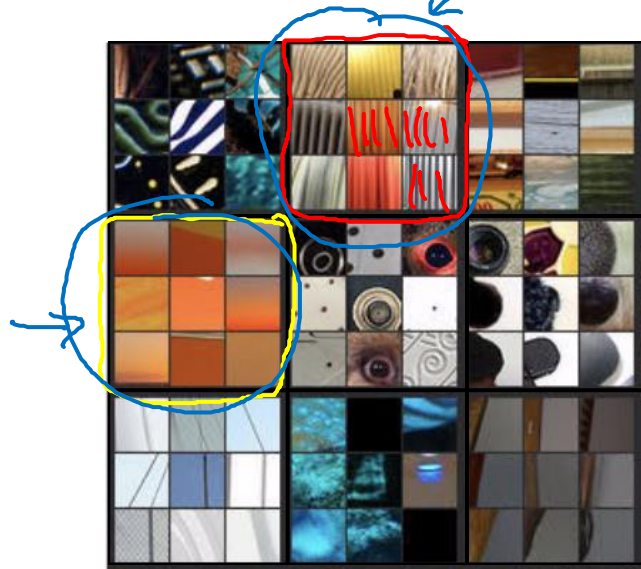Define style as correlation between activations across channels.
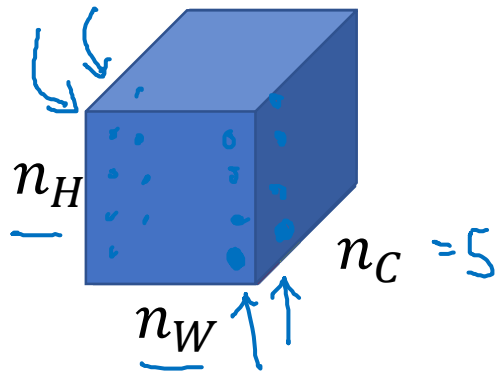
How correlated are the activations across different channels?

[Gatys et al., 2015. A neural algorithm of artistic style]

Andrew Ng

Intuition about style of an image

Style image   Generated Image

n_H n_C n_W

Correlated?

Uncorrelated

n_H n_C n_W

[Gatys et al., 2015. A neural algorithm of artistic style]   Andrew Ng

Style matrix

Let $a^{[l]}_{i,j,k}$ = activation at (i, j, k). $G^{[l]}$ is $n^{[l]}_c \times n^{[l]}_c$

$H \quad W \quad C$

n_c

$G^{[l]}_{kk'}$

$k = 1, \ldots, n^{[l]}_c$

$$G^{[l](S)}_{kk'} = \sum_{i=1}^{n^{[l]}_H} \sum_{j=1}^{n^{[l]}_W} a^{[l](S)}_{ijk} a^{[l](S)}_{ijk'}$$

$$G^{[l](G)}_{kk'} = \sum_{i=1}^{n^{[l]}_H} \sum_{j=1}^{n^{[l]}_W} a^{[l](G)}_{ijk} a^{[l](G)}_{ijk}$$

"gram matrix"

$$J^{[l]}_{style}(S, G) = \frac{1}{(\cdots)} \left\| G^{[l](S)} - G^{[l](G)} \right\|^2_F$$

β

$$= \frac{1}{(2 n^{[l]}_H n^{[l]}_W n^{[l]}_c)^2} \sum_k \sum_{k'} \left(G^{[l](S)}_{kk'} - G^{[l](G)}_{kk'} \right)^2$$

[Gatys et al., 2015. A neural algorithm of artistic style]   Andrew Ng

Style cost function

$$J_{style}^{[l]}(S, G) = \frac{1}{\left(2 n_H^{[l]} n_W^{[l]} n_C^{[l]}\right)^2} \sum_k \sum_{k'} \left(G_{kk'}^{[l](S)} - G_{kk'}^{[l](G)}\right)$$

$$\left\| G^{[l](S)} - G^{[l](G)} \right\|_F^2$$

$$J_{style}(S,G) = \sum_l \lambda^{[l]} J_{style}^{[l]}(S,G)$$

$$J(G) = \alpha J_{content}(C,G) + \beta J_{style}(S,G)$$

$$G$$

[Gatys et al., 2015. A neural algorithm of artistic style]

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