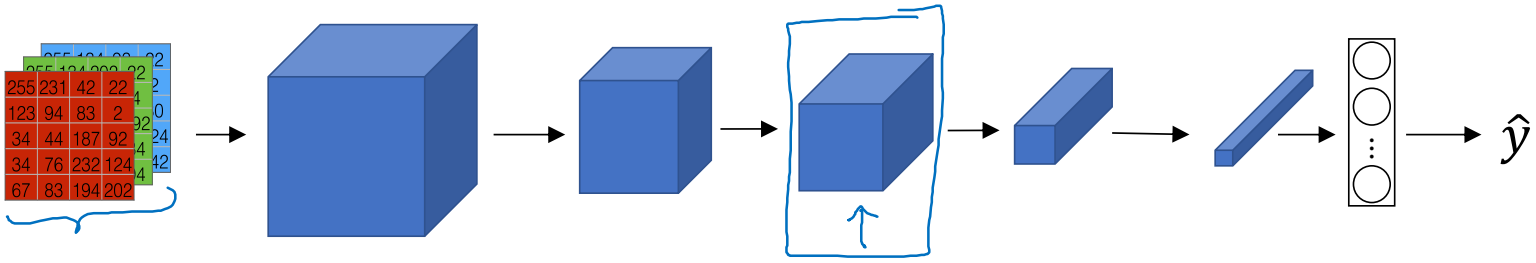
deeplearning.ai

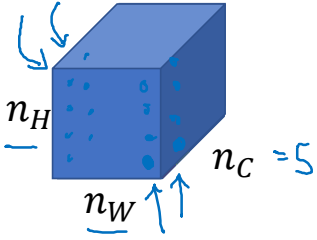
# Neural Style Transfer

## Style cost function

# 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.

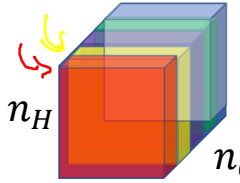



How correlated are the activations across different channels?

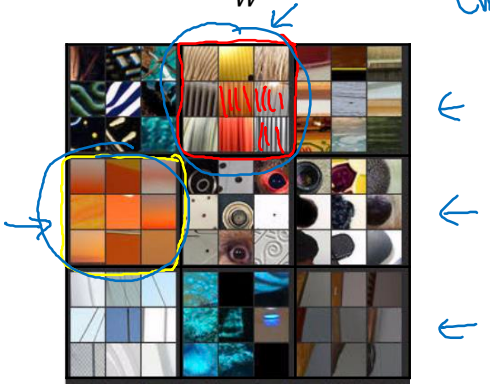
[Gatys et al., 2015. A neural algorithm of artistic style]

# Intuition about style of an image

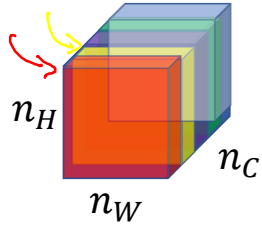
Style image




Correlated?
Uncorrelated



Generated Image




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

# Style matrix

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

H W C

$n_c$

$G^{[l]}_{kk'}$, $k = 1, \ldots, n_c^{[l]}$

$$G^{[l](S)}_{kk'} = \sum_{i=1}^{n_H^{[l]}} \sum_{j=1}^{n_W^{[l]}} a^{[l](S)}_{ijk} \, a^{[l](S)}_{ijk'}$$

$$G^{[l](G)}_{kk'} = \sum_{i=1}^{n_H^{[l]}} \sum_{j=1}^{n_W^{[l]}} a^{[l](G)}_{ijk} \, a^{[l](G)}_{ijk'}$$

"Gram matrix"

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

$$= \frac{1}{(2 n_H^{[l]} n_W^{[l]} n_c^{[l]})^2} \sum_k \sum_{k'} \left( G^{[l](S)}_{kk'} - G^{[l](G)}_{kk'} \right)^2$$

$\beta$

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

# Style cost function

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

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

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

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

$$\min_G J(G)$$

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