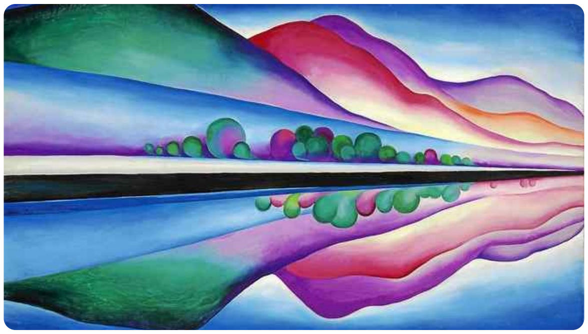
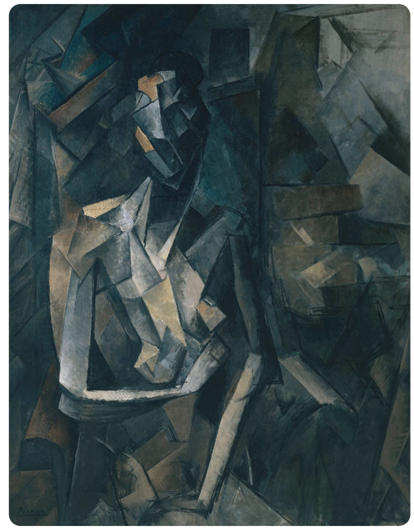
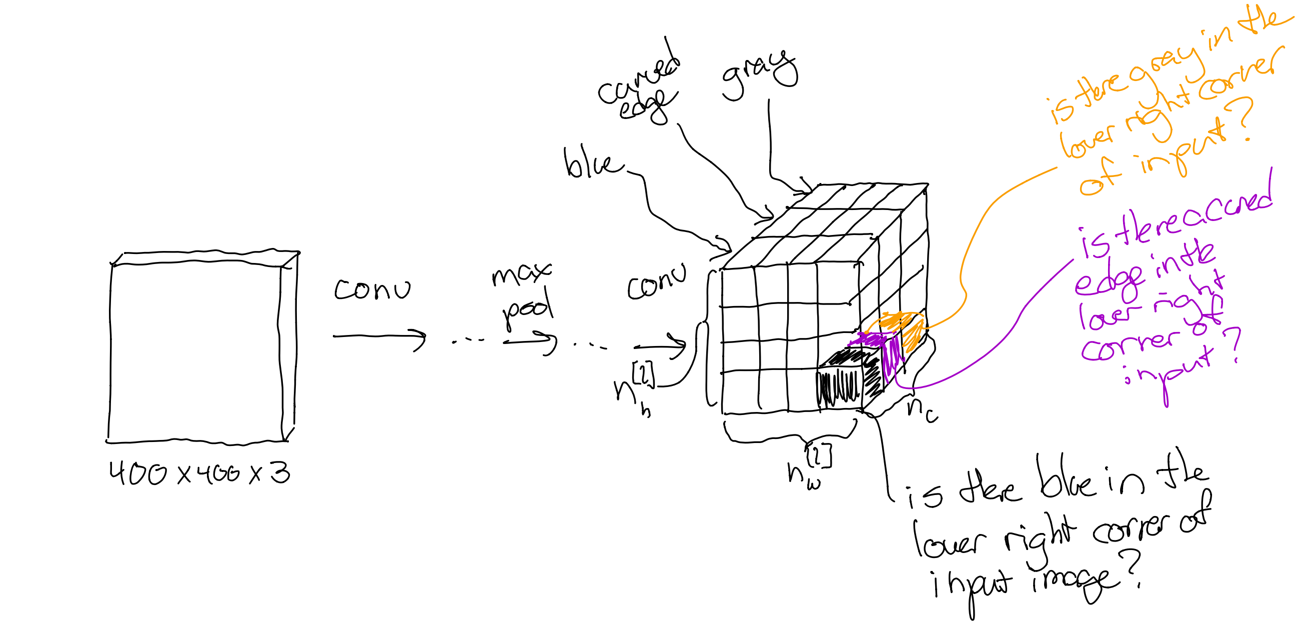


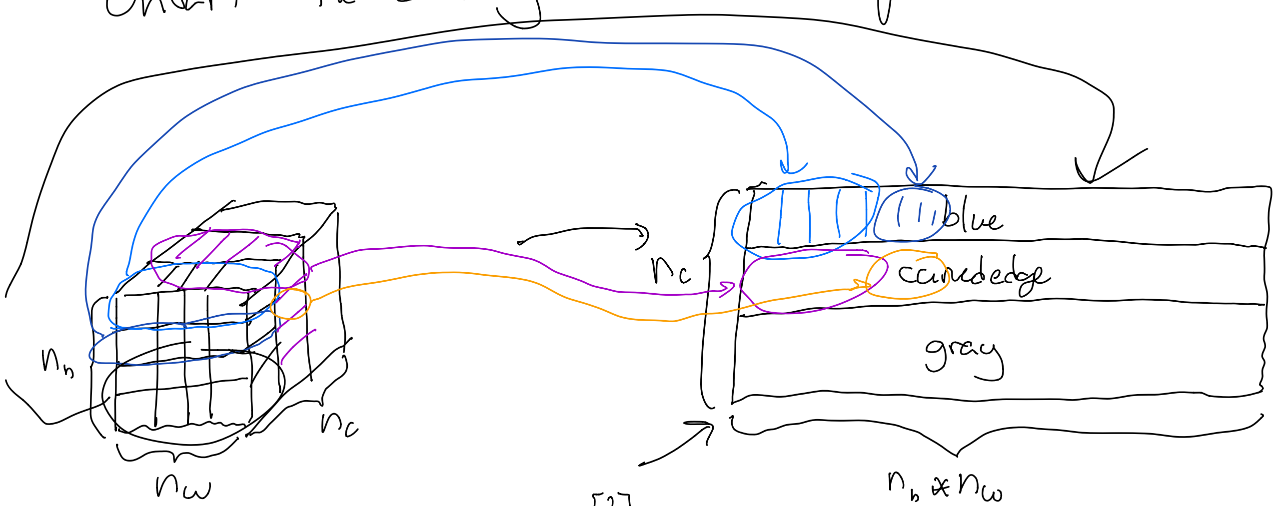


We want to measure co-occurence of different colors and textures

↳ how often does blue and a smooth curve appear in the same location of an image?



"Unroll" the 3d array of activation outputs into a matrix



$F^{[2]}$

Consider the inner product of the first 2 rows $F_1^{[2]}$ and $F_2^{[2]}$

↳ this measures similarity of these vectors

For Georgia O'Keeffe: $F_1^{[2]}$: | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |

$F_2^{[2]}$: | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

$$F_1^{[2]} \cdot (F_2^{[2]})^T = F_1^{[2]} \cdot F_2^{[2]} = 0+0+1+1 \ \cdots \ + 1+1 = 4$$

It measures whether that combination of color and texture occurs together in a consistent way across the full image.

We could also find

$$F_1^{[2]} \cdot F_3^{[2]} \quad \text{and} \quad F_2^{[2]} \cdot F_3^{[2]}$$

These dot products are the entries of the <u>Gram matrix</u> (Gramian):

$$F^{[2]} \cdot \left(F^{[2]}\right)^T$$

$$= \begin{bmatrix} \text{---} & F_1^{[2]} & \text{---} \\ \text{---} & F_2^{[2]} & \text{---} \\ & \vdots & \\ \text{---} & F_{n_c}^{[2]} & \text{---} \end{bmatrix} \begin{bmatrix} | & | & & | \\ \left(F_1^{[2]}\right)^T & \left(F_2^{[2]}\right)^T & \cdots & \left(F_{n_c}^{[2]}\right)^T \\ | & | & & | \end{bmatrix}$$

$$= \begin{bmatrix} F_1^{[2]} \cdot \left(F_1^{[2]}\right)^T & F_1^{[2]} \cdot \left(F_2^{[2]}\right)^T & \cdots & F_1^{[2]} \left(F_{n_c}^{[2]}\right)^T \\ \vdots & & \ddots & \vdots \\ F_{n_c}^{[2]} \cdot \left(F_1^{[2]}\right)^T & \cdots & & F_{n_c}^{[2]} \cdot \left(F_{n_c}^{[2]}\right)^T \end{bmatrix}$$

This matrix summarizes co-occurrence of all pairs of color/texture features across the full input image.