

# Neural Style Transfer using CNN

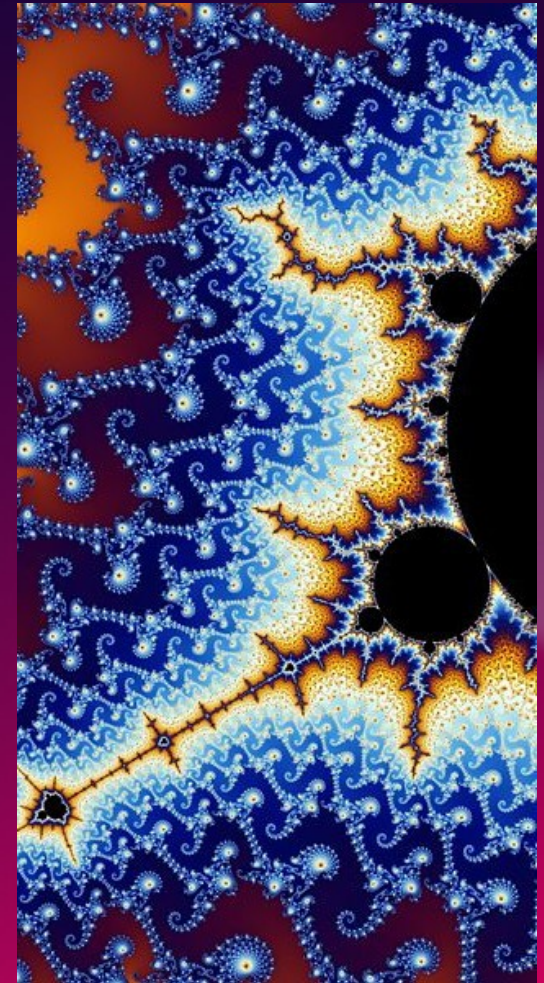
Image reconstruction

[www.deepart.io](http://www.deepart.io)

[www.deepdreamgenerator.com](http://www.deepdreamgenerator.com)

# Development of creative AI

- 1952: Ben Laposky, 'Oscillons' oscilloscope
- 1965: Frieder Nake, Hommage à Paul Klee
- 1970: Univ. of London, Exp.Com.Dep.
- 1978: Fractals, eg. Mandelbrot
- 1980: James Faure Walker, 'Dark Filament'
- 1985: Digital Artwork, Andy Warhol
- 1992: First New York Digital Salon
- 1998: Digital Art Museum, Wolfgang Lieser
- 2003: Launch of second life
- 2008: TV Art for the Digital Generation
- 2008: Synthetic organisms
- 2018: AI artwork sells for \$432,500, Christie's

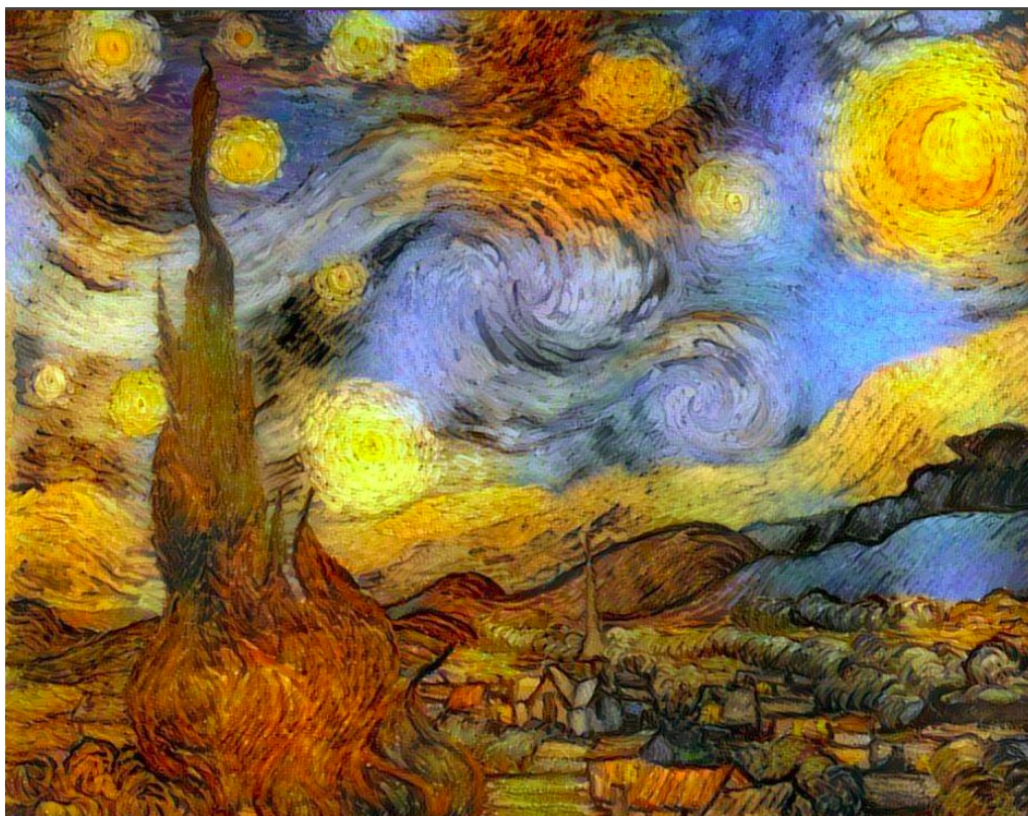


# Neural Style Transfer (NST)

Neural style transfer is an optimization technique used to take two images—a content image and a style reference image (such as an artwork by a famous painter)—and blend them together so the output image looks like the content image, but “painted” in the style of the style reference image.

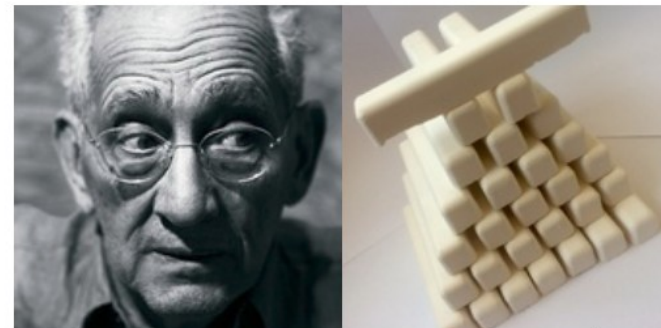


# Examples from [www.deepdreamgenerator.com](http://www.deepdreamgenerator.com)





# Examples from [www.deepart.io](http://www.deepart.io)



# Art movement and styles

- Surrealism
- Impressionism
- Cubism
- Pop Art
- Naturalism
- Abstract
- Dada/Dadaism
- Expressionism
- Minimalism
- Classicism



[www.artyfactory.com](http://www.artyfactory.com)



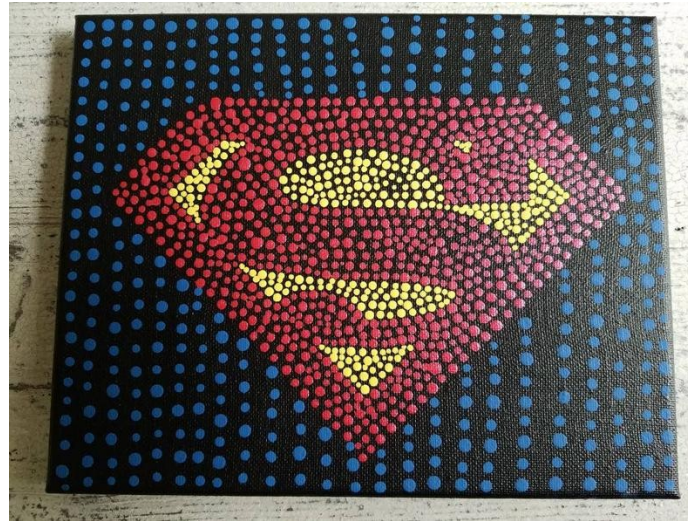
# Materials and Techniques

## Materials:

- Oil pastels.
- Watercolors.
- White colored pencil
- Pointillism with acrylics.
- Drawing with pencils.
- Colored pencils.

## Techniques:

- Underpainting
- Blocking in
- Building up texture
- Dry brushing
- Glazing
- Scraper

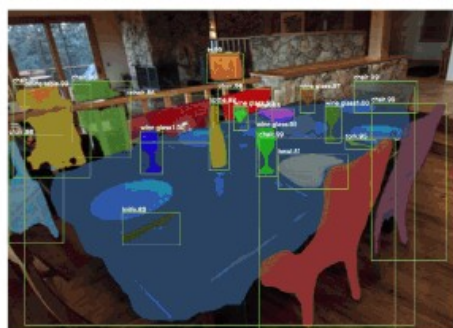
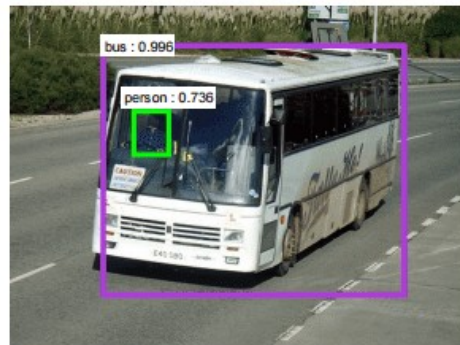
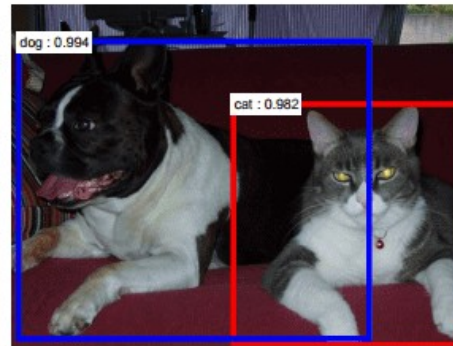
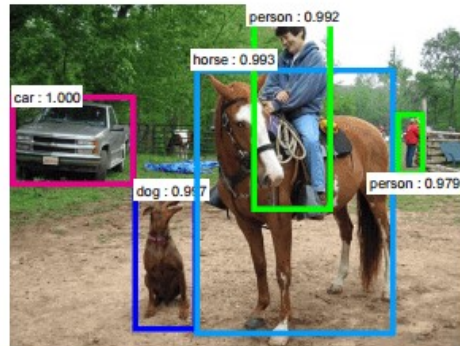


[www.etsy.com](http://www.etsy.com)



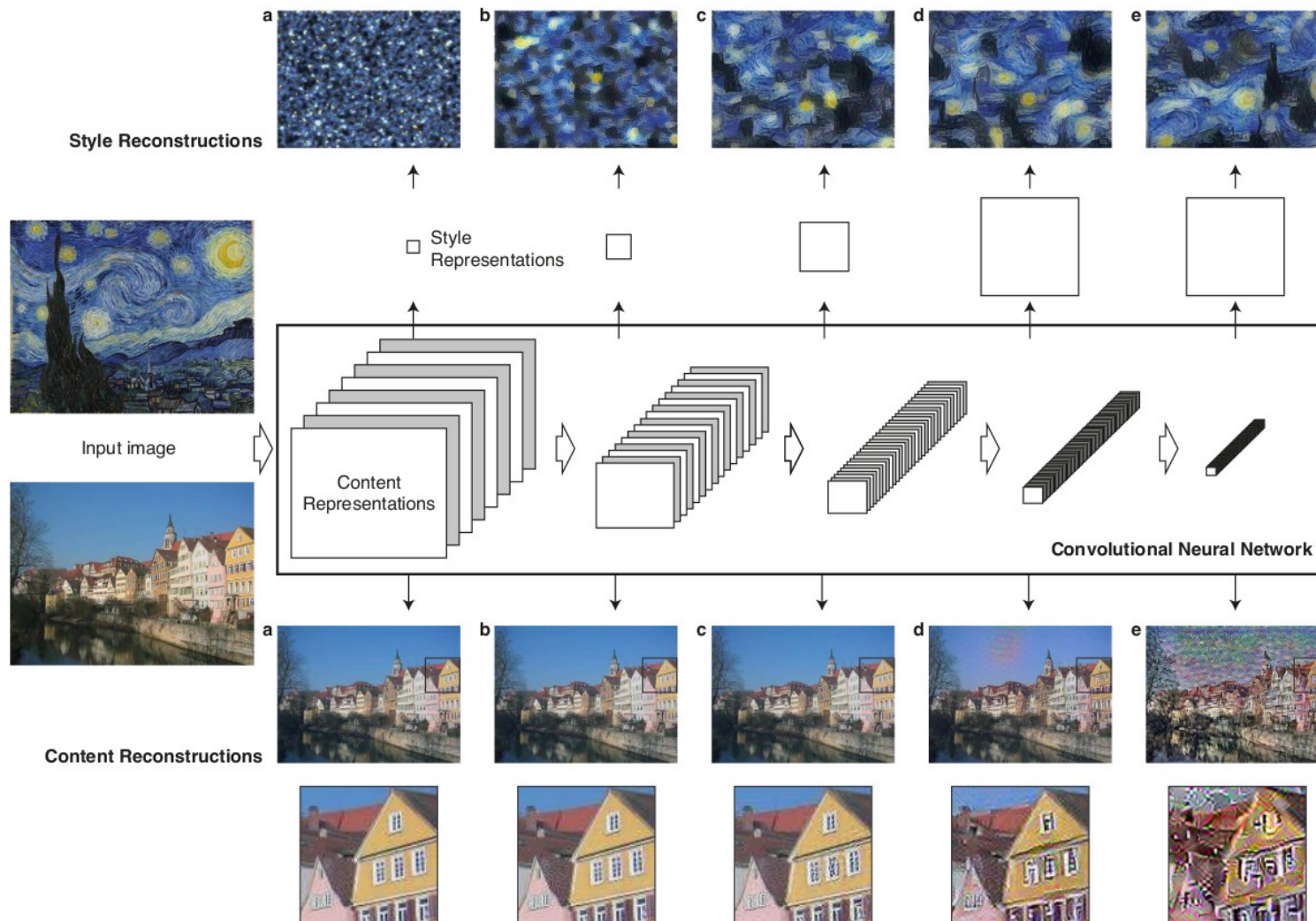
[www.webartacademy.com](http://www.webartacademy.com)

- Faces
- Cars
- Houses
- Dogs
- Cats
- Chairs
- Tables
- Books
- Plants

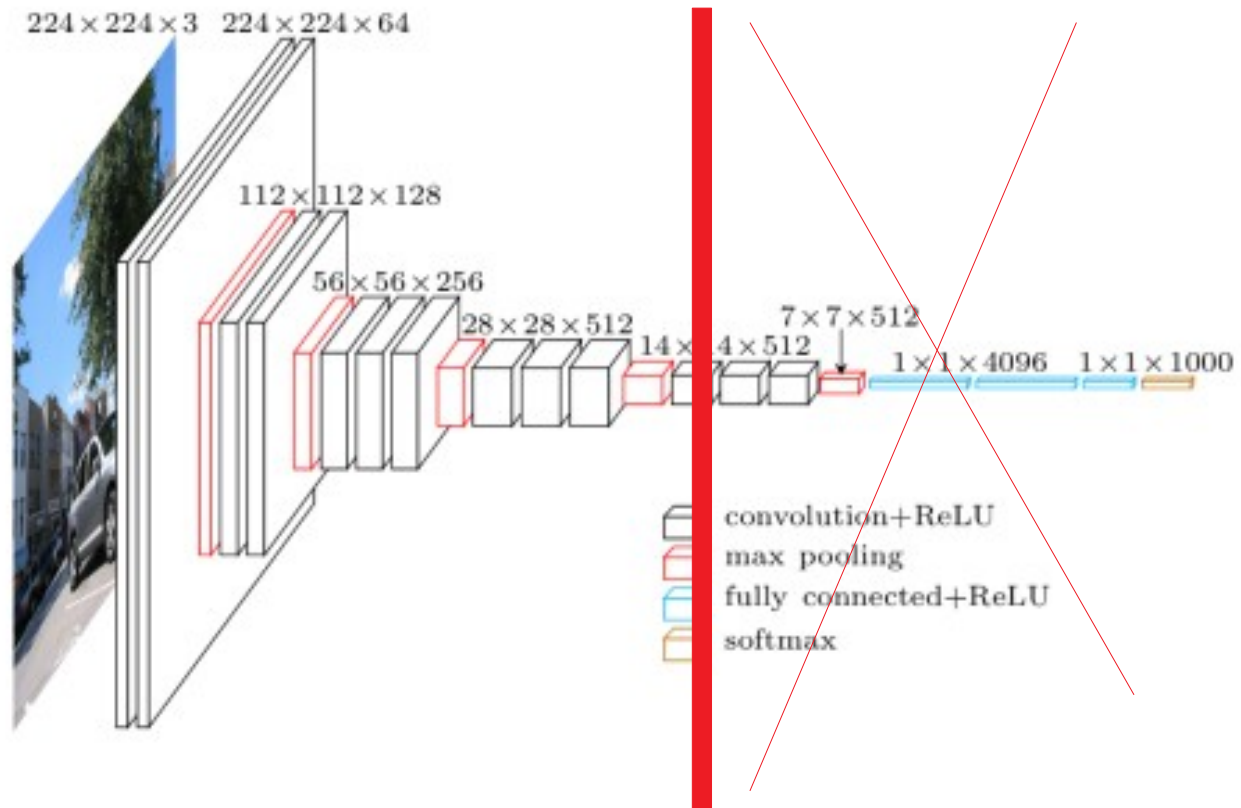




# Image representation in a CNN

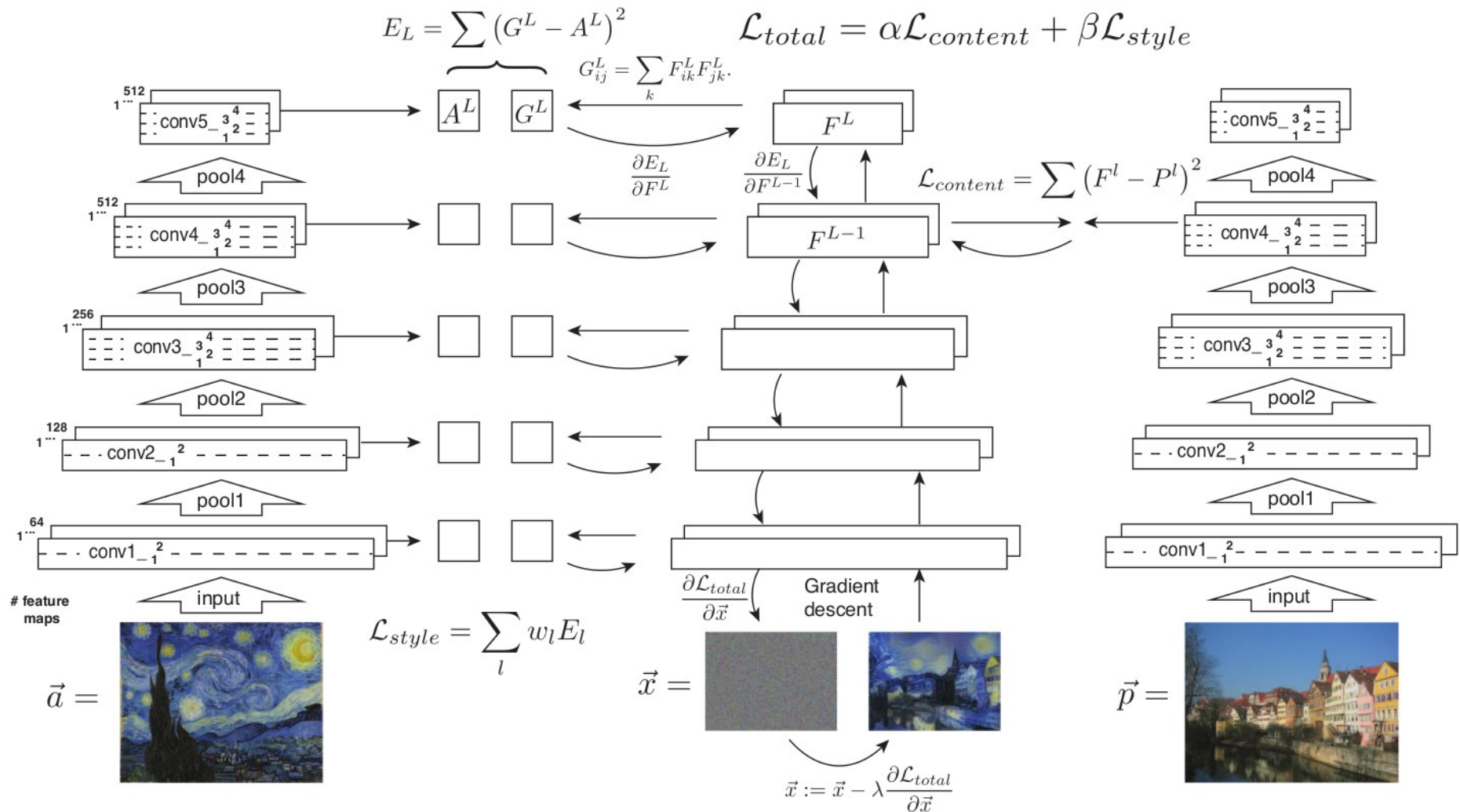


# VGG19



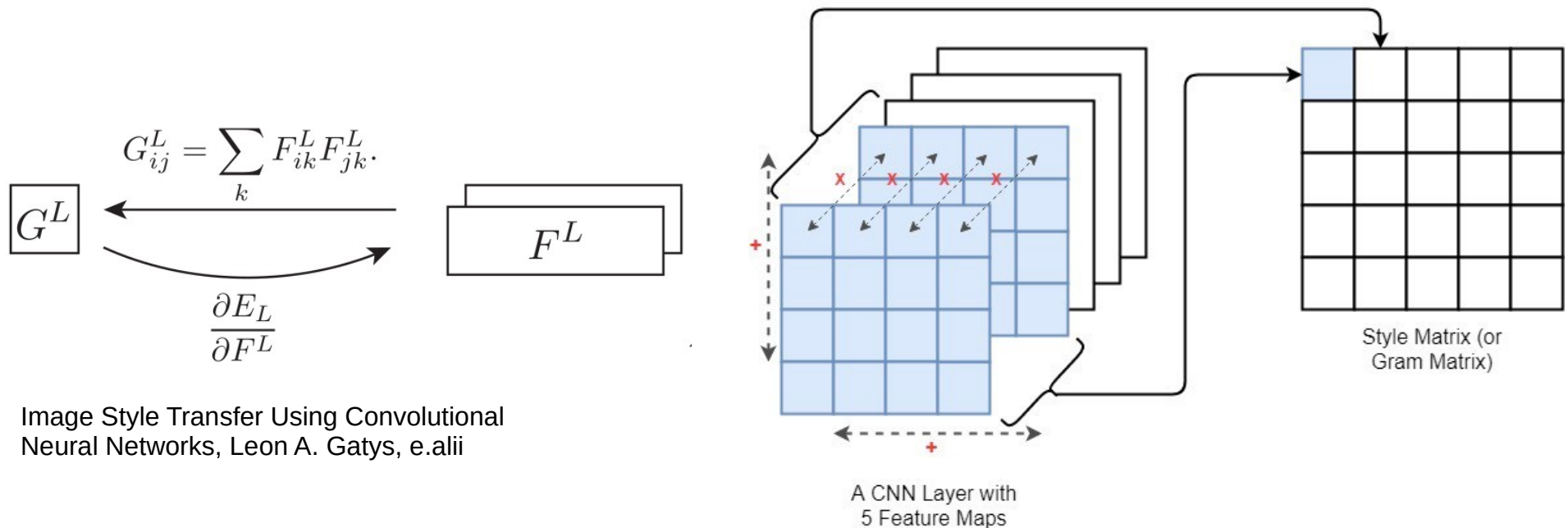


# Style transfer algorithm



# Gram Matrix

Where the  $(i,j)$  th element of the style matrix is computed by computing the element wise multiplication of the  $i$  th and  $j$  th feature maps and summing across both width and height. In the figure, red cross denotes element wise multiplication and the red plus sign denotes summing across both width height of the feature maps.



How the Style Matrix is Computed for a CNN Layer with 5 Feature Maps



# Definition of a Loss function

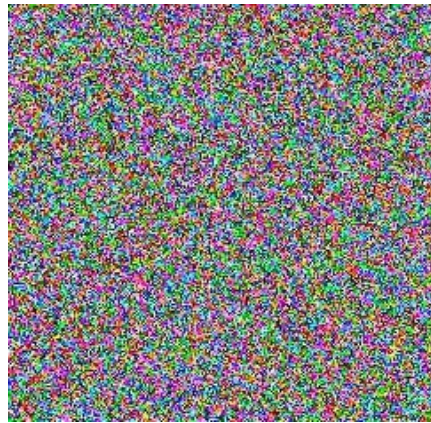
$$\mathcal{L}_{total} = \alpha \mathcal{L}_{content} + \beta \mathcal{L}_{style}$$

$$\mathcal{L}_{content} = \sum (F^l - P^l)^2$$

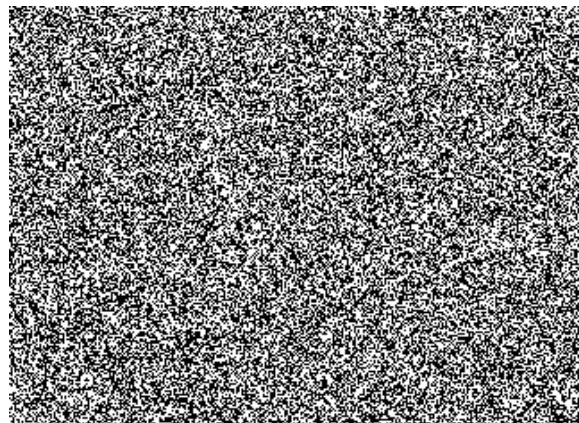
$$\mathcal{L}_{style} = \sum_l w_l E_l$$

$$\vec{x} := \vec{x} - \lambda \frac{\partial \mathcal{L}_{total}}{\partial \vec{x}}$$

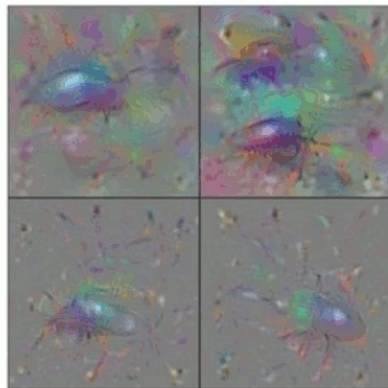
# Image reconstruction from white noise or random color image



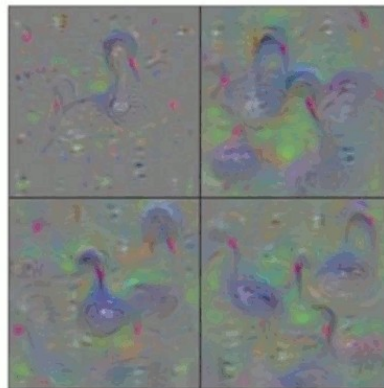
[www.yosinski.com](http://www.yosinski.com)



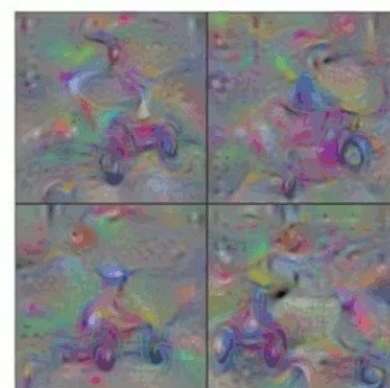
[www.iceyboard.no-ip.org](http://www.iceyboard.no-ip.org)



Ground Beetle



Black Swan



Tricycle

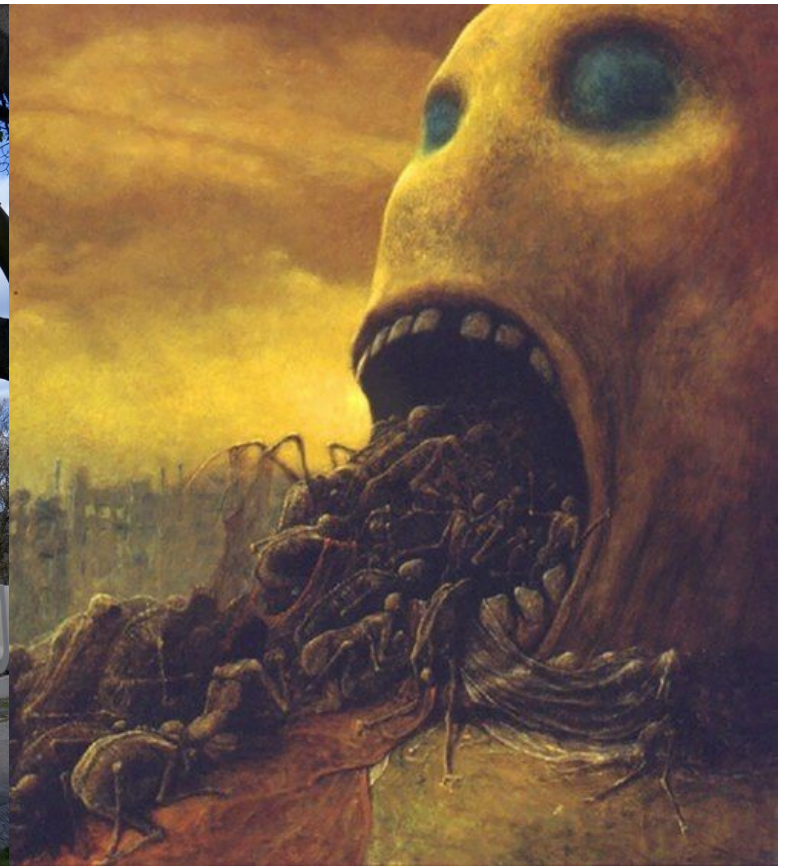
[www.yosinski.com](http://www.yosinski.com)



# Thank you for your attention



[www.berliner-woche.de](http://www.berliner-woche.de)



[www.i.pinimg.com](http://www.i.pinimg.com)



# The new Beuth



[www.deepart-io](http://www.deepart-io)