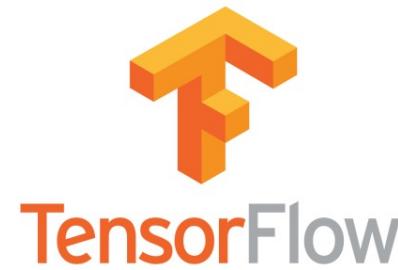
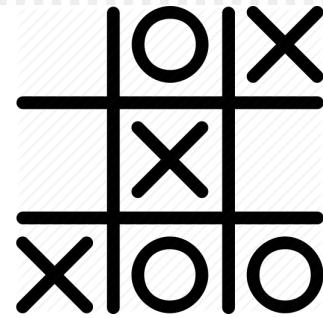
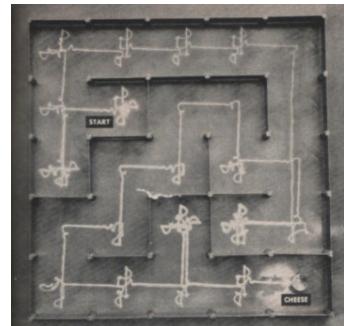
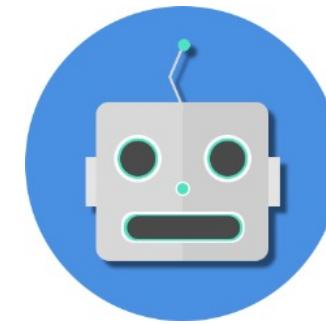
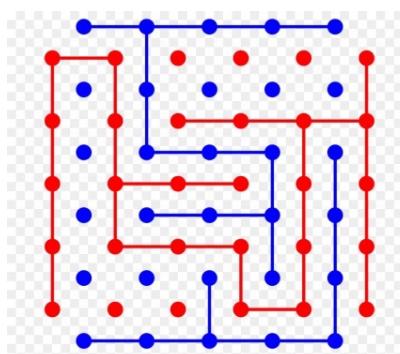
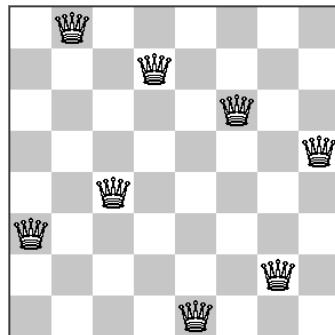


Artificial Intelligence:

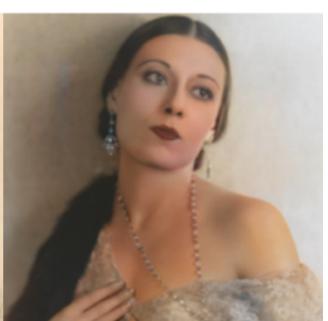
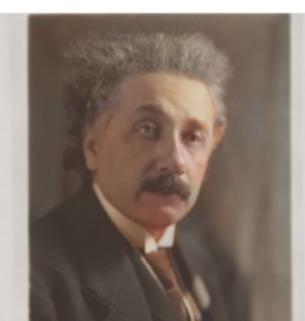
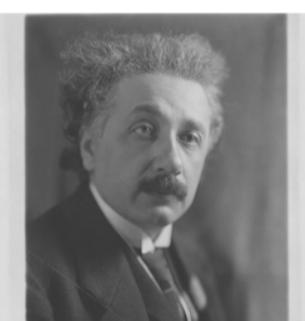
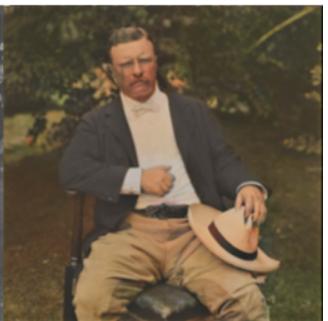
Past, Present and Future



Chee Wei Tan

AI Colorization

- Up until the mid-1940s, photographs were in black and white due to limitations in the understanding of optics and technologies
- Take a grayscale image as input and output a colorized version of it



Booker T. Washington

Amelia Earhart

Teddy Roosevelt

Helen Keller

Albert Einstein

Dolores del Rio

Colorization History

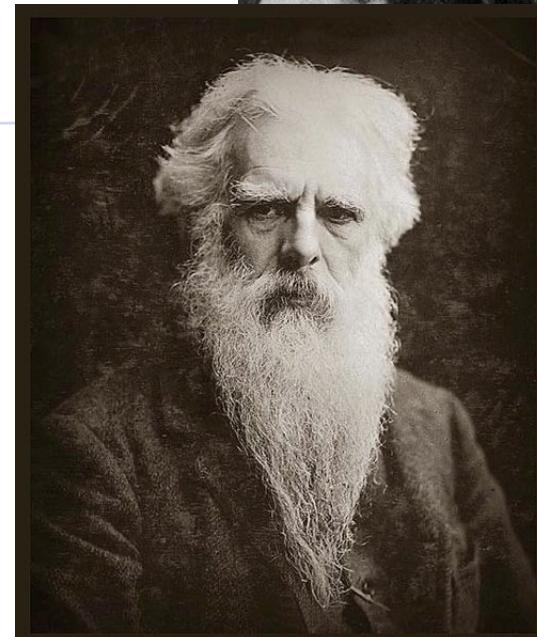
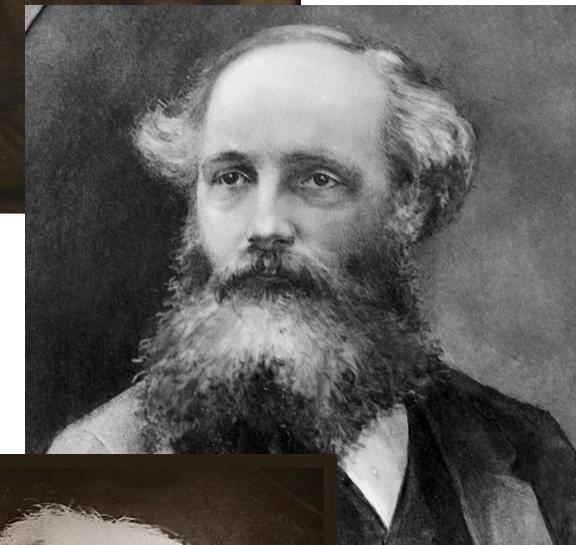
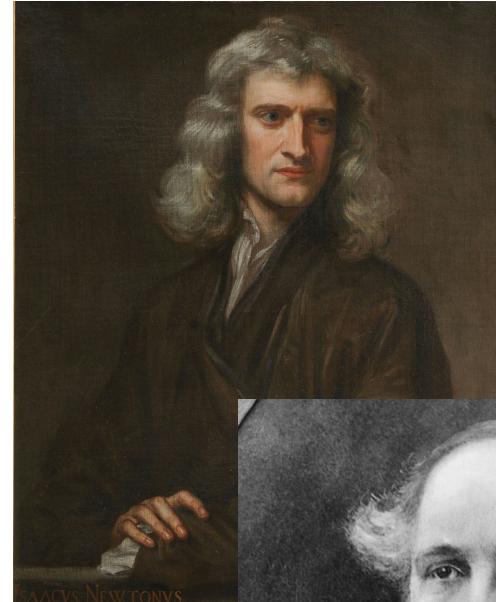
Isaac Newton began a series of experiments with sunlight and prisms. He demonstrated that clear white light was composed of seven visible colors.

1666

1861

1872

James Clerk Maxwell and photographer Thomas Sutton took the first color photo

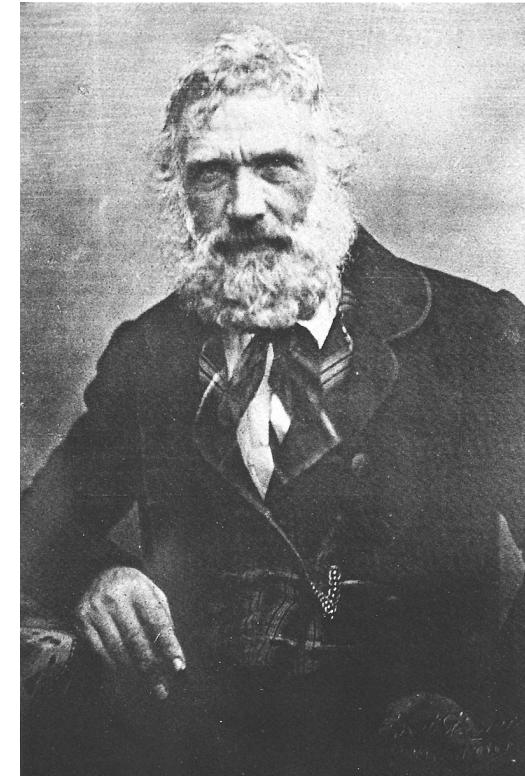


Coloring photographs by hand

- Johann Baptist Isenring (1893) developed a coloring method for his proofs, which he patented in America
- Produced the first colored daguerreotype using a mixture of gum Arabic and pigments



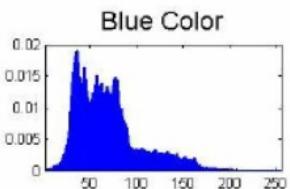
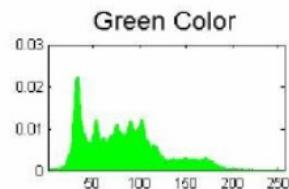
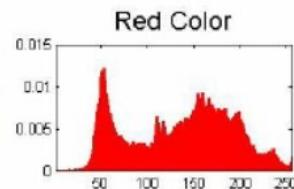
The Königssee at Berchtesgaden (1823)



Johann Baptist Isenring (1796-1860)

Early 2000s

- Early computer-assisted method: **Texture synthesis**
- This approach matches the **three-dimensional distribution** (RGB) of color values between the images and then transforms the color distribution of the target image to match the distribution of the source image
- Advances in signal processing and wavelets by Ingrid Daubechies



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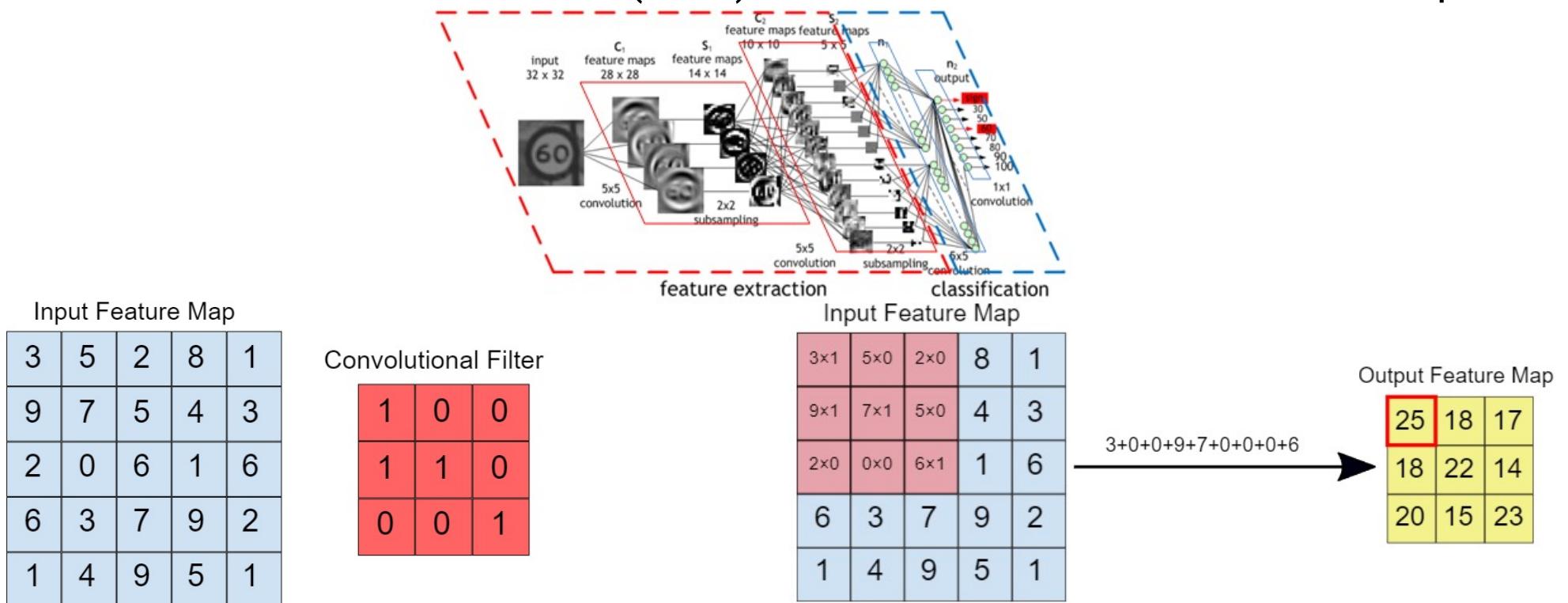


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Deep Learning: Convolutional Neural Networks

- **Convolutional Neural Network (CNN)**: a number of convolutional layers to filter inputs for useful information (extract features)
- The convolution operation involves combining input data (feature map) with a **convolution kernel** (filter) to form a transformed feature map.



Deep Learning-based Colorization

- Computational pipeline for **classification, detection, and segmentation** by CNNs
- Constraints on colorization based on semantic meanings, e.g., the grass is green, the sky is blue, and ladybugs are red



Fig. 1. Example input grayscale photos and output colorizations from our algorithm. These examples are cases where our model works especially well. Please visit <http://richzhang.github.io/colorization/> to see the full range of results and to try our model and code. Best viewed in color (obviously).

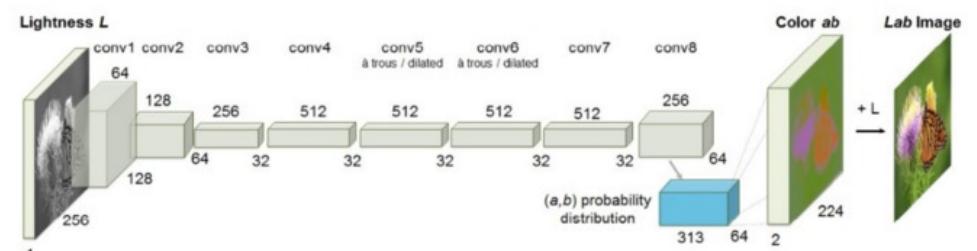
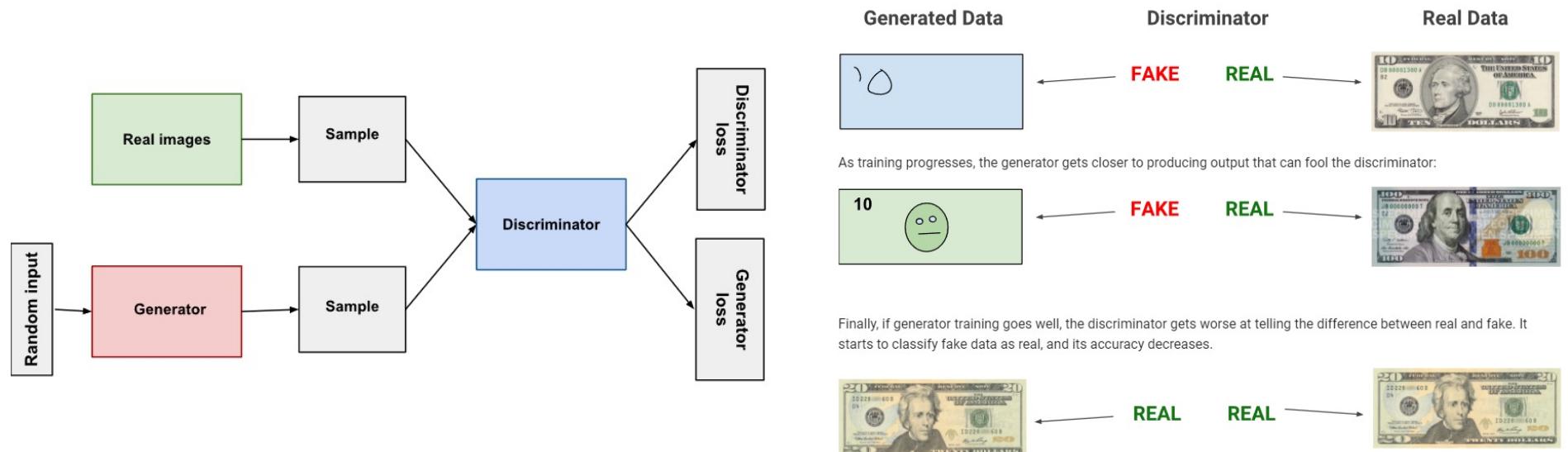


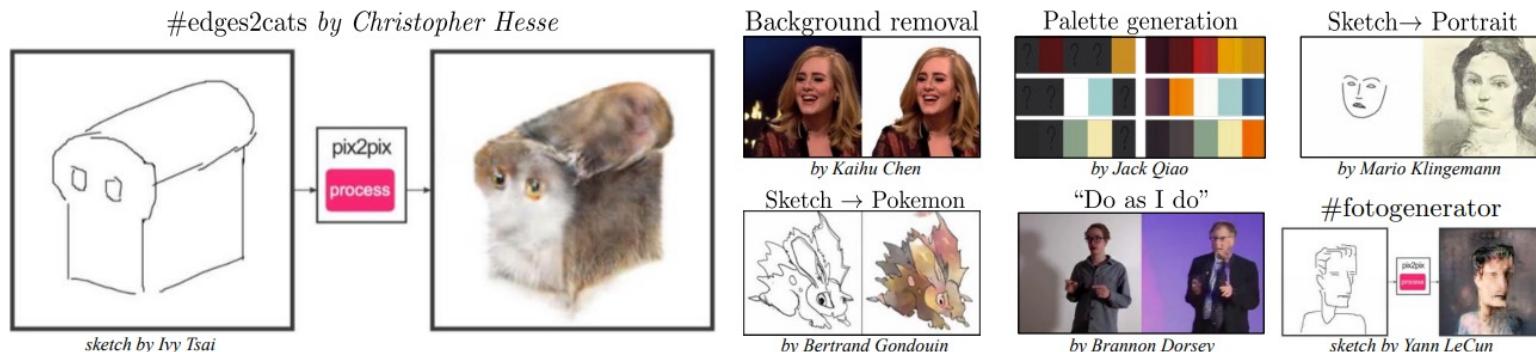
Fig. 2. Our network architecture. Each **conv** layer refers to a block of 2 or 3 repeated **conv** and **ReLU** layers, followed by a **BatchNorm** [30] layer. The net has no **pool** layers. All changes in resolution are achieved through spatial downsampling or upsampling between **conv** blocks.

Deep Learning: Generative Adversarial Networks

- **Generative Adversarial Network (GAN):** Two CNN neural networks play a zero-sum game with each other to create new data resembling the training data

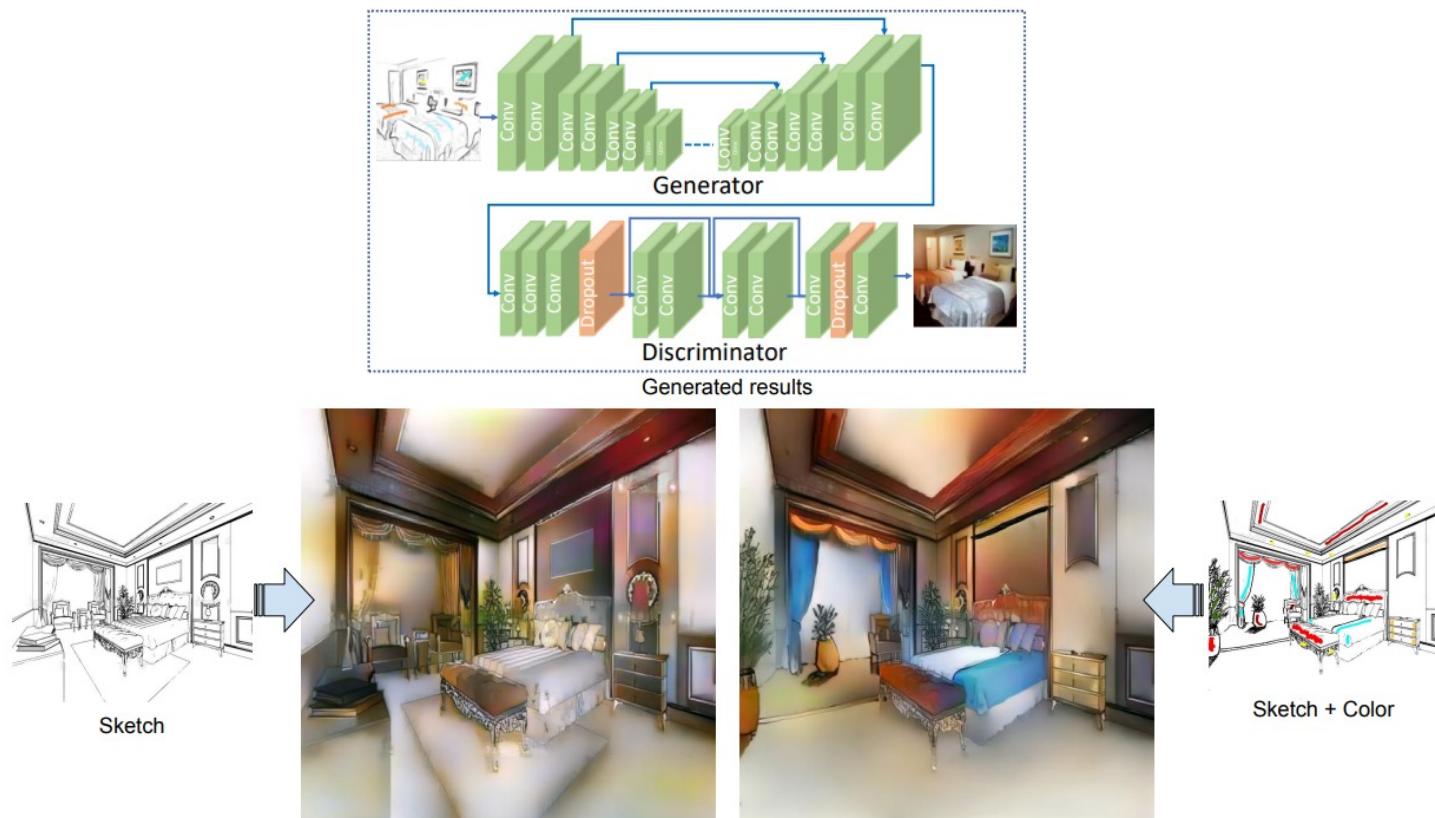


- NVIDIA's StyleGAN: <https://youtu.be/9QuDh3W3lOY>
- Pix2pix: A GANs model for general purpose image-to-image translation



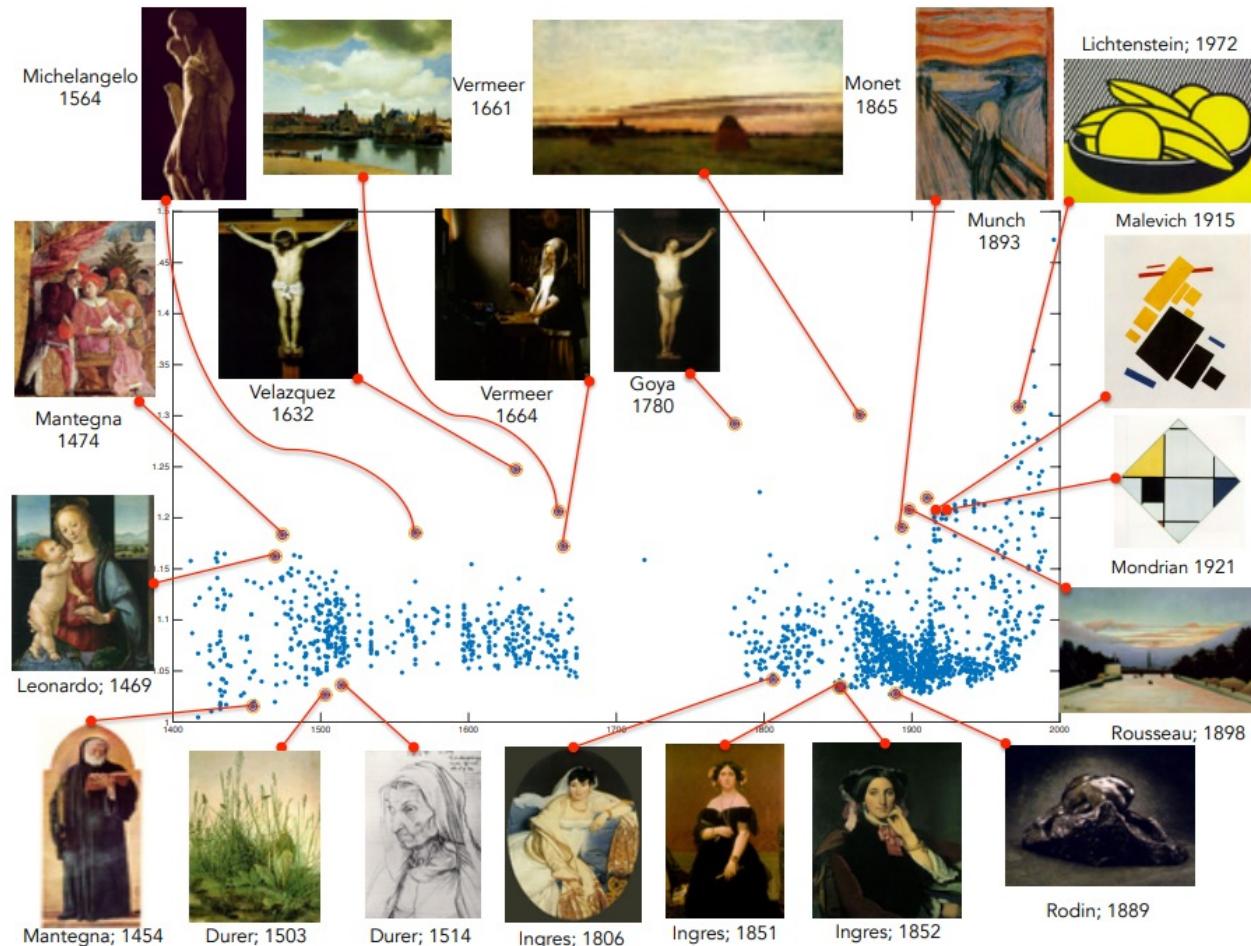
User-Guided AI

- Scribbler: End-to-end feed-forward deep GAN
- User input in the form of sketches and color strokes



Quantifying Creativity

- Construct a **Creativity Network** connecting artwork and use the Google's Pagerank algorithm to compute **Creativity Scores** to infer the originality and influence of artwork (nodes in the graph)



Style Classification by Stylometry

- Use Convolutional Neural Network (CNN) and Creativity Network to model the learned representation and feature through correlation analysis with findings in art history to assess the evolution of style

