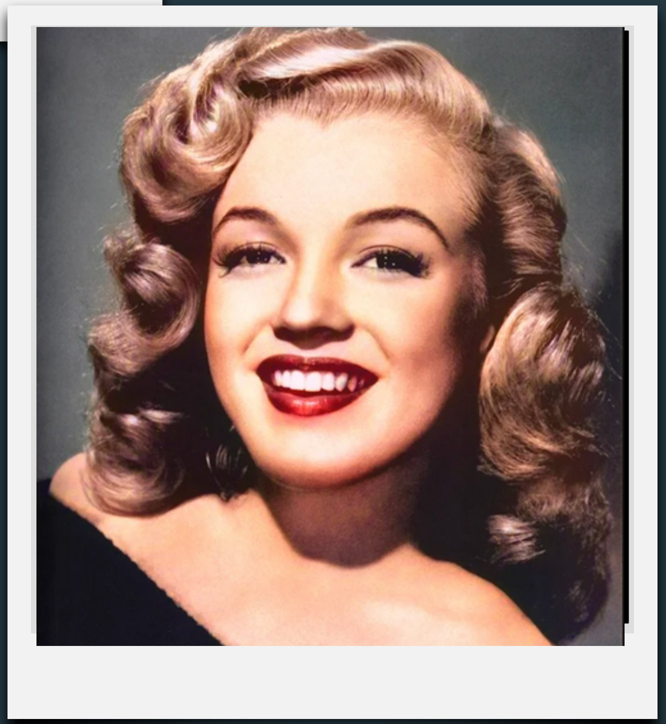
IMAGE COLORIZATION VIA DEEP LEARNING



ARTIFICIAL INTELLIGENCE

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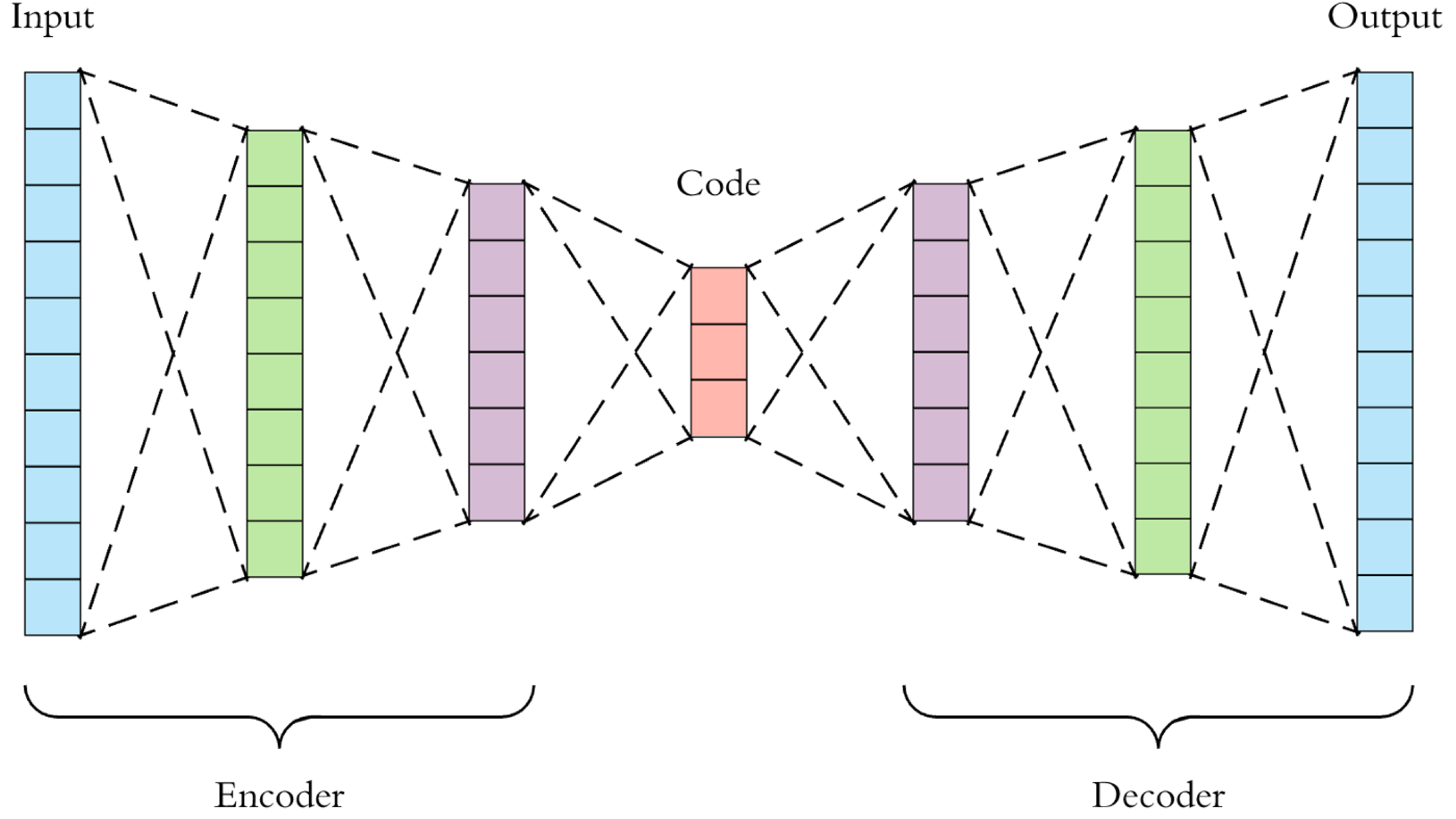
ABSTRACT

Colorizing old images that are in black and white is an important task in computer vision. There are several state-of-the-art models capable of taking on such a task in the present scenario. We are going to leverage and train one such AI model, with which we aim to make a publicly usable web app that will allow any user to colorize black-and-white imagery with just one click.

ARCHITECTURE OF ARTIFICIAL INTELLIGENCE SYSTEM

- The architecture used by us is called an Autoencoder. It is an advanced kind of deep learning neural network that works on the concept of learning smaller encodings of the data representation.

- In essence, it takes the data fed to it in the form of images, attempts to pass the data through its multiple dense layers, and creates a small learned encoding. This latent space representation is dimensionally much smaller than the input or output size.



Input
Output
Code
Encoder
Decoder

ARCHITECTURE OF ARTIFICIAL INTELLIGENCE SYSTEM

- In a way, we can think of the architecture as boiling the data down in a bottleneck fashion only to its most essential and critical elements.

- The learning problem is framed as a paired image-to-image translation problem where the model tries to learn how to convert a given black and white image (input) to its corresponding color image (ground truth).

ARCHITECTURE OF ARTIFICIAL INTELLIGENCE SYSTEM

- Hence, we can make use of a reconstruction loss that compares the image outputted by our model and the original color image.

- The model is then penalized according to its performance in the form of a loss function, which the model (the AI agent basically) tries to minimize.

BREAKING IT DOWN

- An autoencoder includes two primary parts: the **encoder** and the **decoder**.

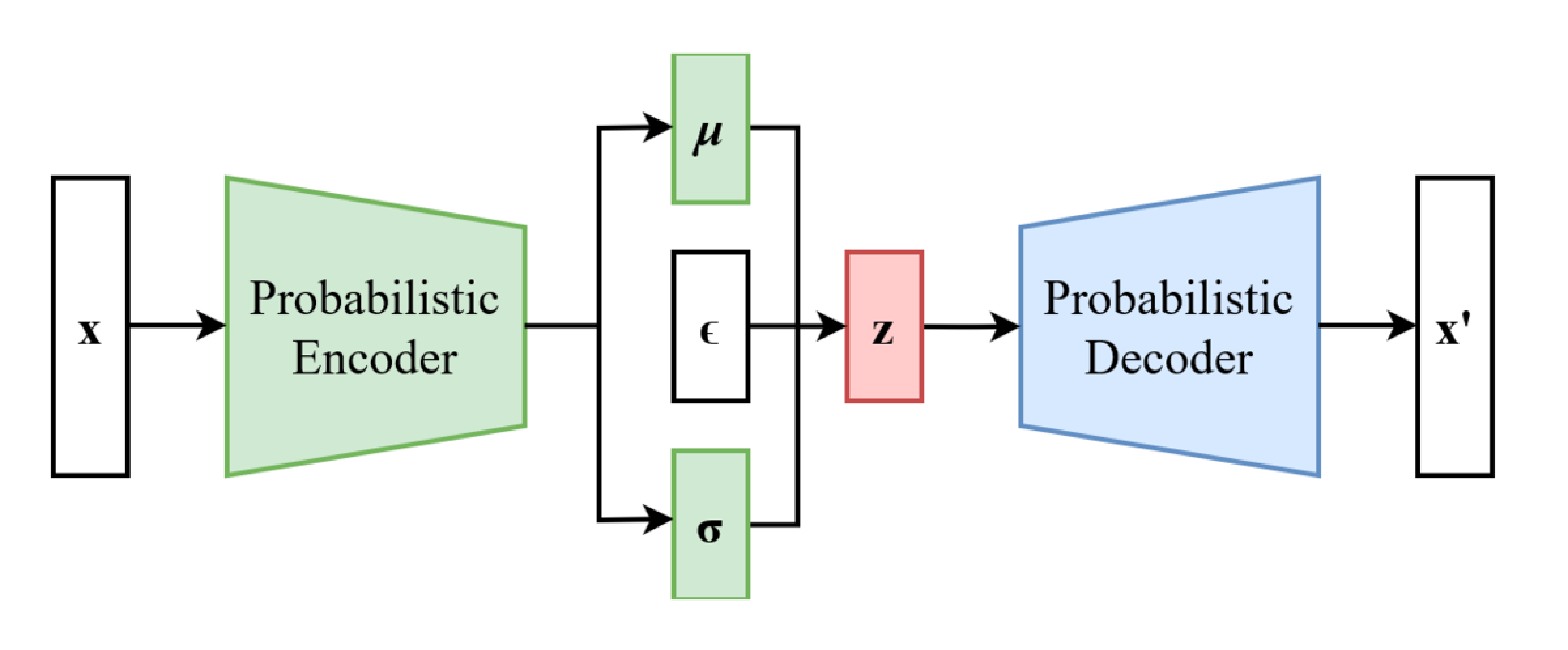
- It is the **encoder's job** to take the input data presented and **compress it into a dimensionally smaller latent-space representation** i.e. an encoding.

- Subsequently, it is the **decoder's job** to take the encoding and try to **reconstruct a color image** from it.

VARIATIONAL AUTOENCODER

- In our architecture, we use a variant of the autoencoder called the Variational Autoencoder.
- Although similar in their essence, they differ a bit in how the latent space representation is created.
- The VAE makes use of two novelties that make it stand out:
  - Reparameterization Trick
  - KL-Divergence Loss

VARIATIONAL AUTOENCODER



VARIATIONAL AUTOENCODER

- VAE is different in a way such that it provides a statistical manner for describing the samples of the dataset in latent space.

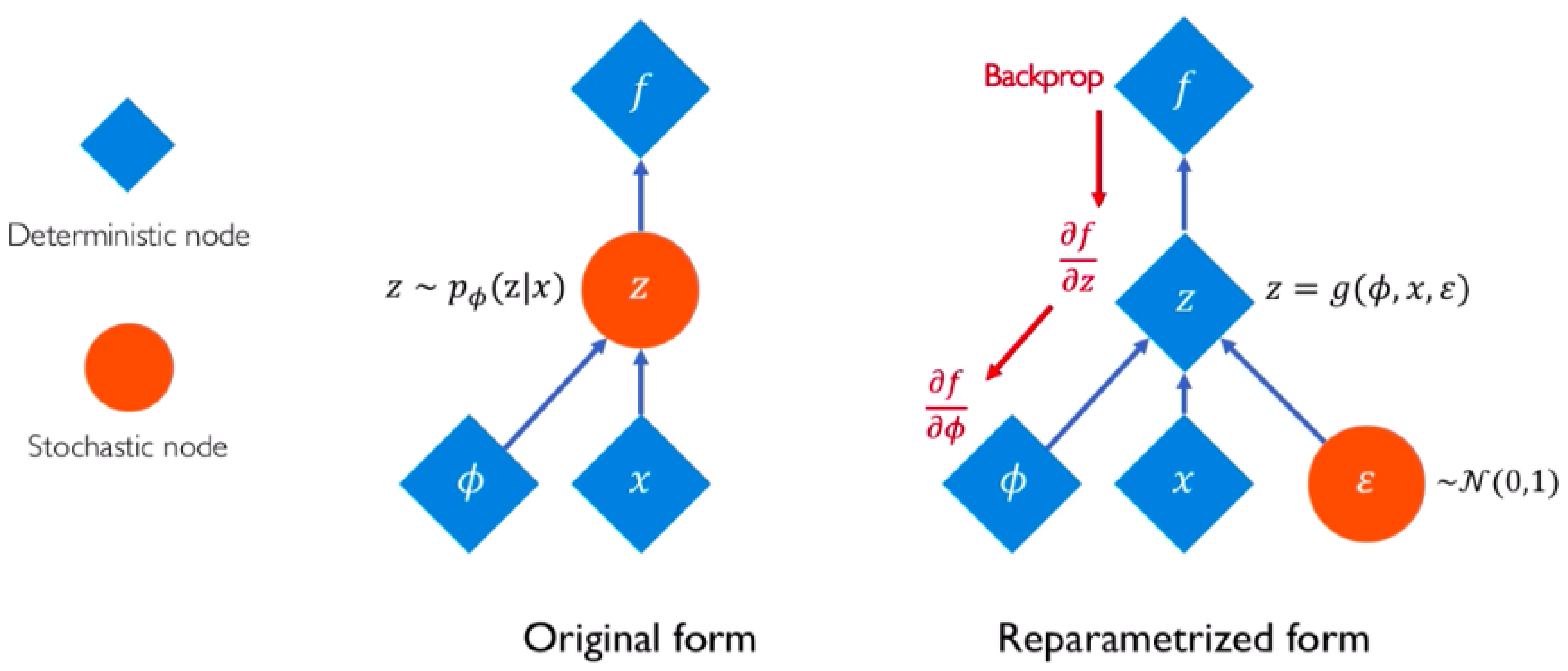
- Here we have a stochastic or random node that introduces this probabilistic idea. However, it is not possible to backpropagate through random nodes.

- To tackle this, VAEs make use of the reparameterization trick.

REPARAMETERIZATION TRICK

- Reparameterizing our VAE network allows the mean and log-variance vectors to still remain as the learnable parameters of the network while still maintaining the stochasticity of the entire system.

VAE network with and without the "reparameterization" trick



KL-DIVERGENCE LOSS

- KL divergence stands for Kullback Leibler Divergence, it is a measure of divergence between two distributions. Our goal is to Minimize KL divergence and optimize one distribution to resemble the required distribution.

- For multiple distribution the KL-divergence can be calculated as the following formula:

$$\frac{1}{2}\sum_{j=1}^{J}(1+log(\sigma_j^{(i)}))\frac{1}{2}\sum_{j=1}^{J}(1+log(\sigma_j^{(i)})^2)-(\mu_j^{(i)})^2-(\sigma_j^{(i)})^2)$$

COLORFUL IMAGE COLORIZATION

This project was inspired by the paper Colorful Image Colorization by Zhang et al...

Colorful Image Colorization

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University of California, Berkeley

Abstract. Given a grayscale photograph as input, this paper attacks the problem of hallucinating a *plausible* color version of the photograph. This problem is clearly underconstrained, so previous approaches have either relied on significant user interaction or resulted in desaturated colorizations. We propose a fully automatic approach that produces vibrant and realistic colorizations. We embrace the underlying uncertainty of the

OUTPUTS

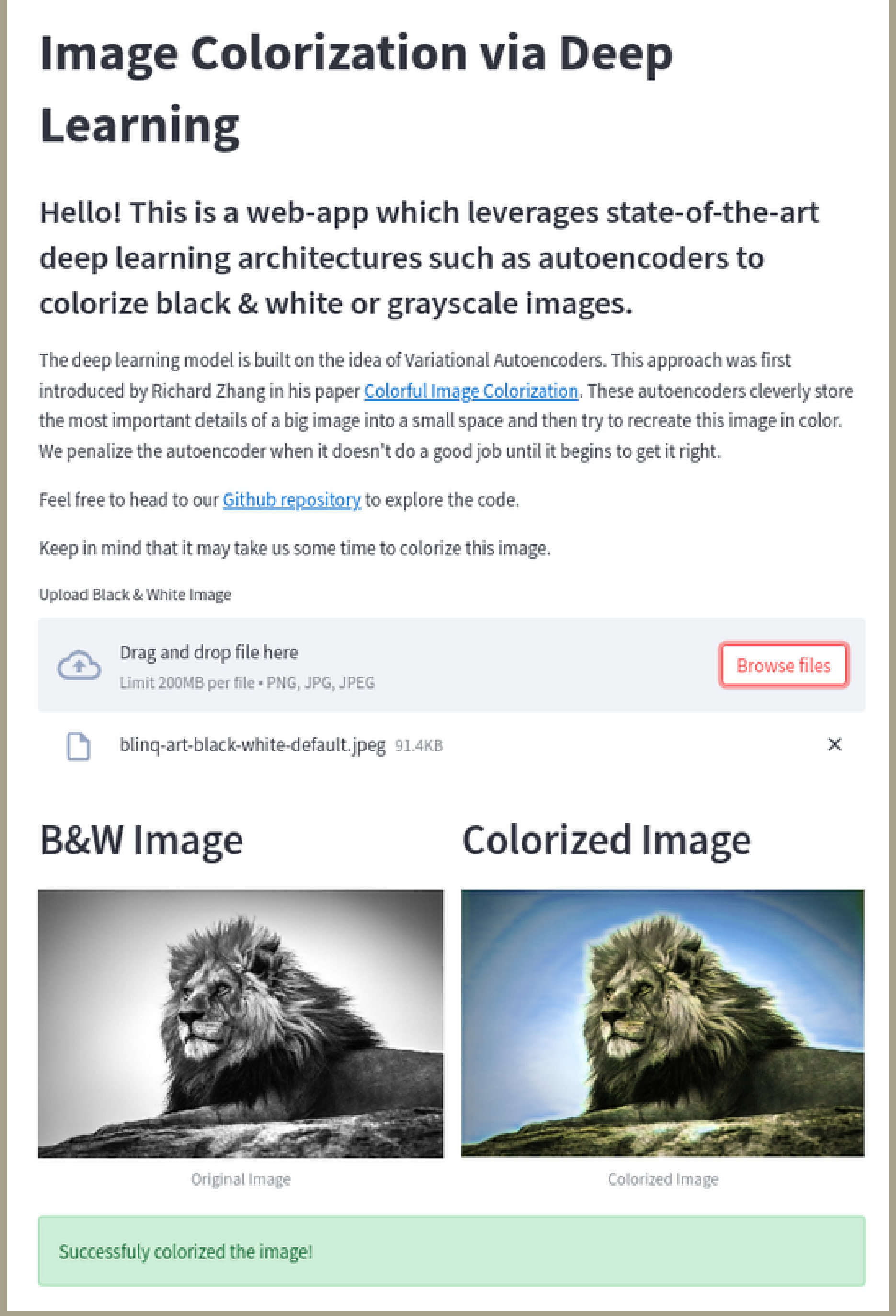
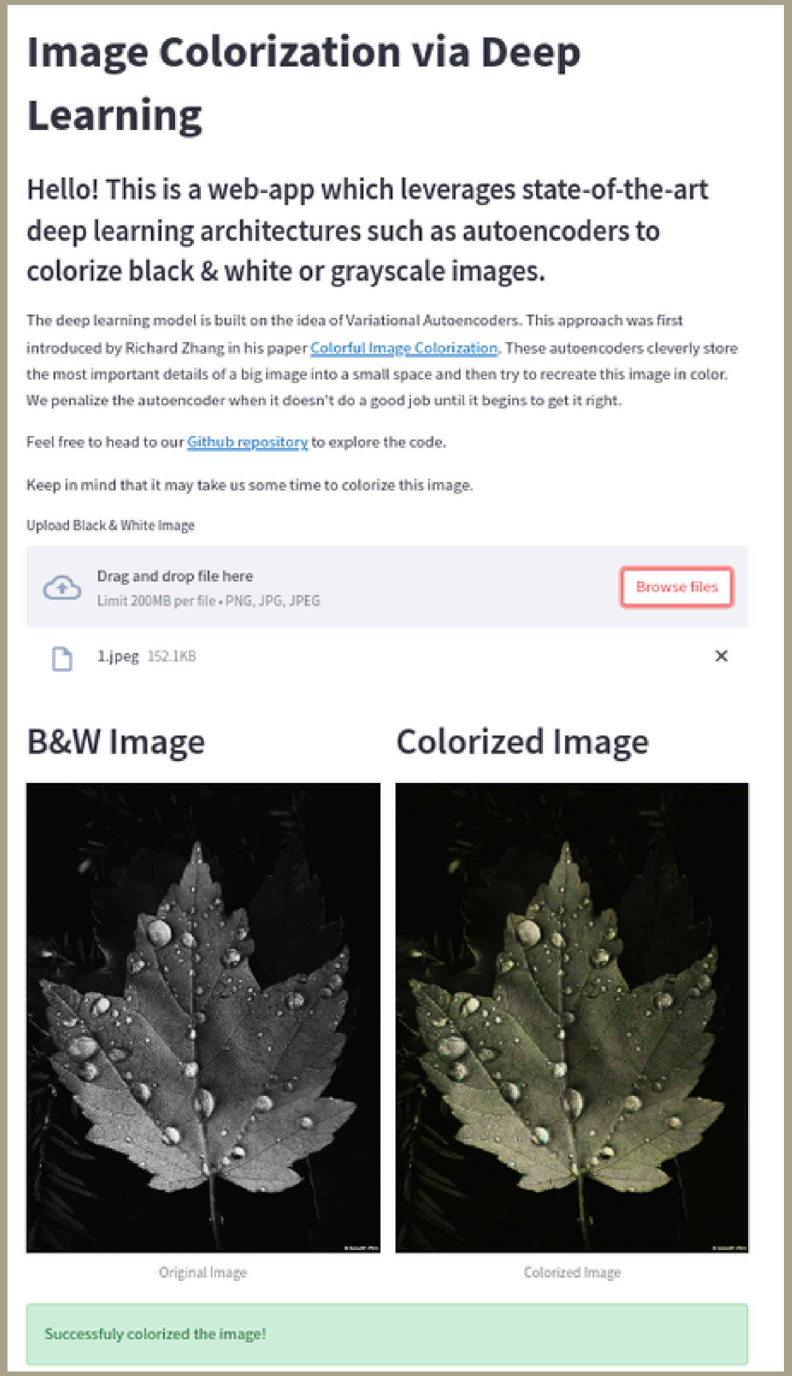


Image Colorization via Deep Learning
Hello! This is a web-app which leverages state-of-the-art deep learning architectures such as autoencoders to colorize black & white or grayscale images.
The deep learning model is built on the idea of Variational Autoencoders. This approach was first introduced by Richard Zhang in his paper Colorful Image Colorization. These autoencoders cleverly store the most important details of a big image into a small space and then try to recreate this image in color. We penalize the autoencoder when it doesn't do a good job until it begins to get it right.
Feel free to head to our Github repository to explore the code.
Keep in mind that it may take us some time to colorize this image.
Upload Black & White Image
Drag and drop file here
Limit 200MB per file • PNG, JPG, JPEG
Browse files
blinq-art-black-white-default.jpeg 91.4KB
B&W Image
Colorized Image
Original Image
Colorized Image
Successfuly colorized the image!



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Browse files
1.jpeg 152.1KB
B&W Image
Colorized Image
Original Image
Colorized Image
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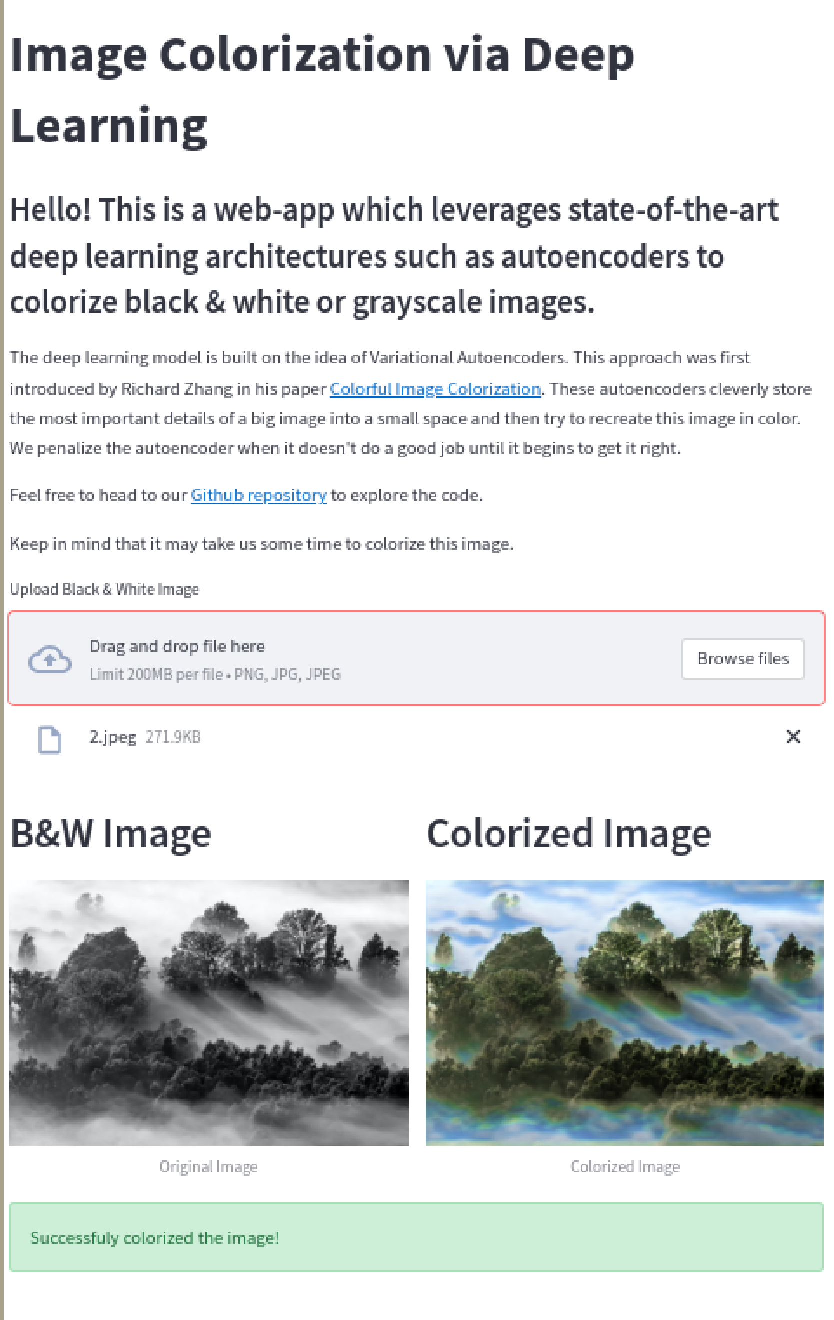

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THANK YOU!

We welcome any questions...