CSE4261: Neural Network and Deep Learning

Lecture: 08.07.2025

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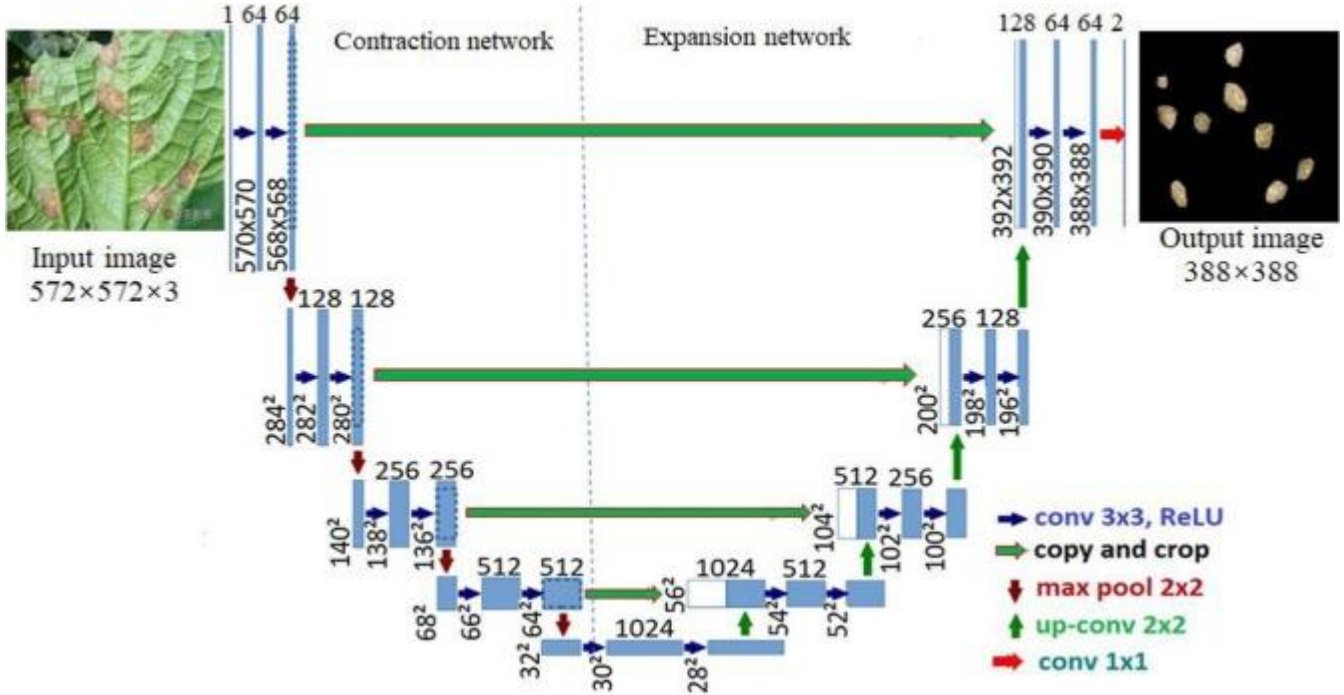
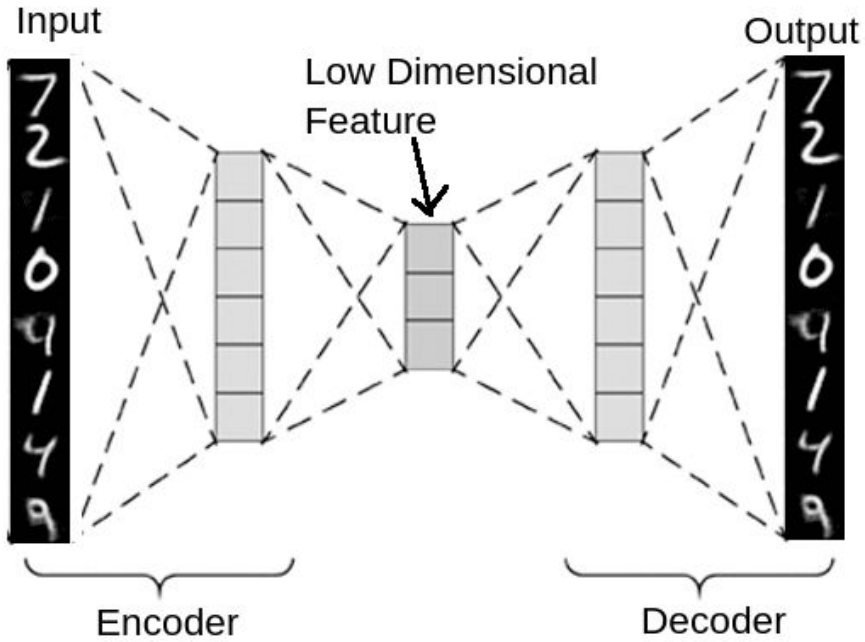
U-Net Segmenter [2015]



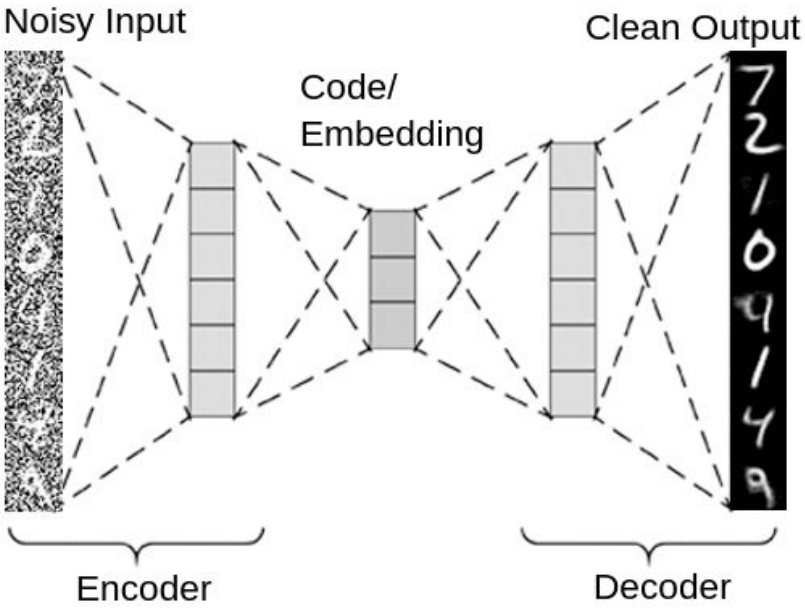
Code: https://keras.io/examples/vision/oxford_pets_image_segmentation/

Autoencoder



Code: https://blog.keras.io/building-autoencoders-in-keras.html
https://keras.io/examples/vision/autoencoder/

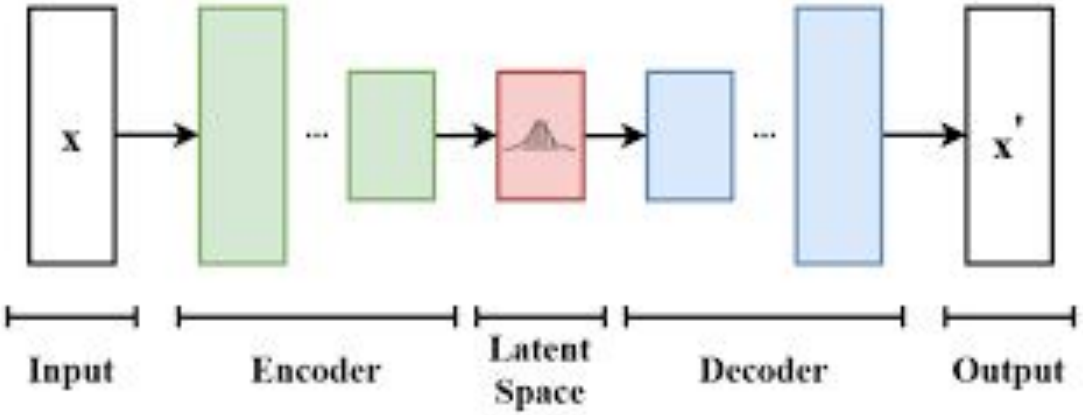
Denoising-Autoencoder



Code: https://blog.keras.io/building-autoencoders-in-keras.html
https://keras.io/examples/vision/autoencoder/

Variational Autoencoder (VAE)

- It is an autoencoder based generative model.
- It is used to generate new data in the form of *variations* of the input data it is trained on.
- Latent vectors are assumed to follow normal distribution



How to Generate a Random Variable

A. Normal Distribution:
   a. known as a Gaussian distribution
   b. is a type of probability distribution that is symmetrical and bell-shaped when graphed.

B. Standard Normal Distribution:
   a. a normal distribution having mean of 0 and standard deviation of 1.

C. Steps of Generating Random Variable following Normal Distribution
   a. Generate a random variable, say $\boldsymbol{\varepsilon}$, from a standard normal distribution.
   b. Then, transform $\boldsymbol{\varepsilon}$ by multiplying it by the desired standard deviation (say, $\boldsymbol{\sigma}$) and adding the desired mean (say $\boldsymbol{\mu}$).
   c. $Z = \boldsymbol{\mu} + \boldsymbol{\sigma} \odot \boldsymbol{\varepsilon}$

Normal Distribution Formula

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

$\mu =$ mean of x

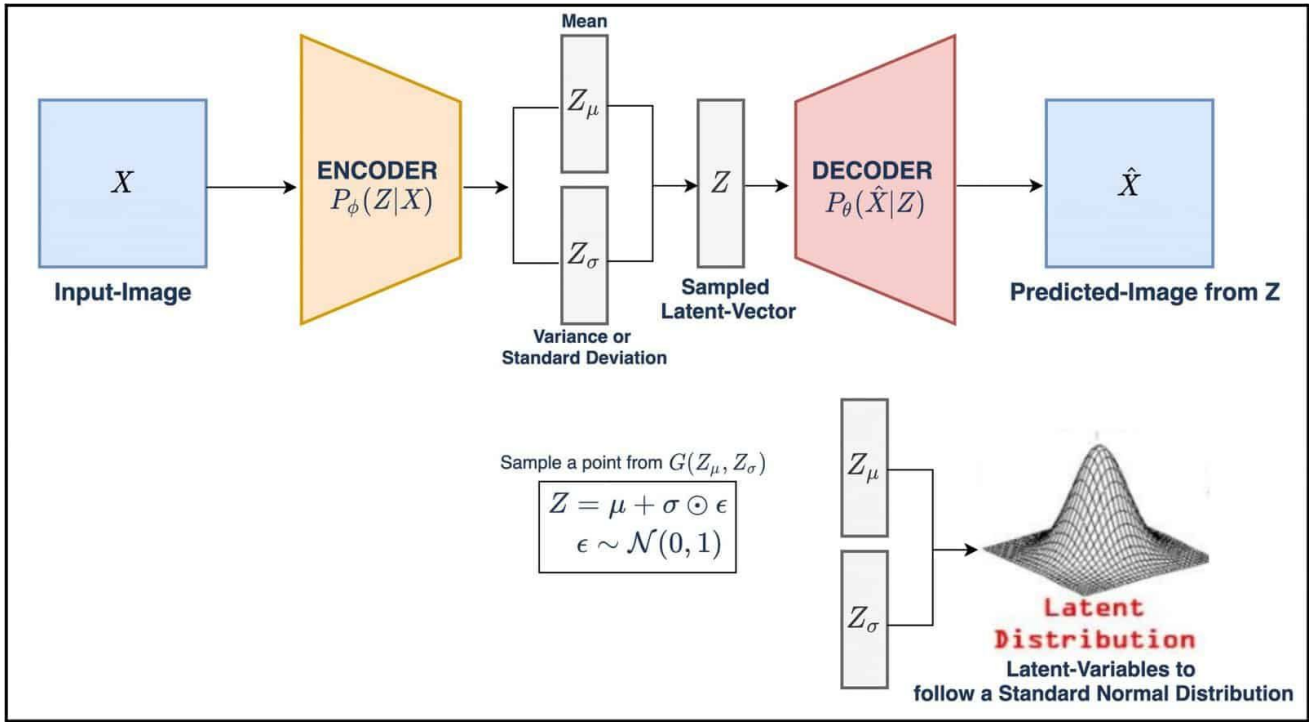
$\sigma =$ standard deviation of x

$\pi \approx 3.14159 \ldots$

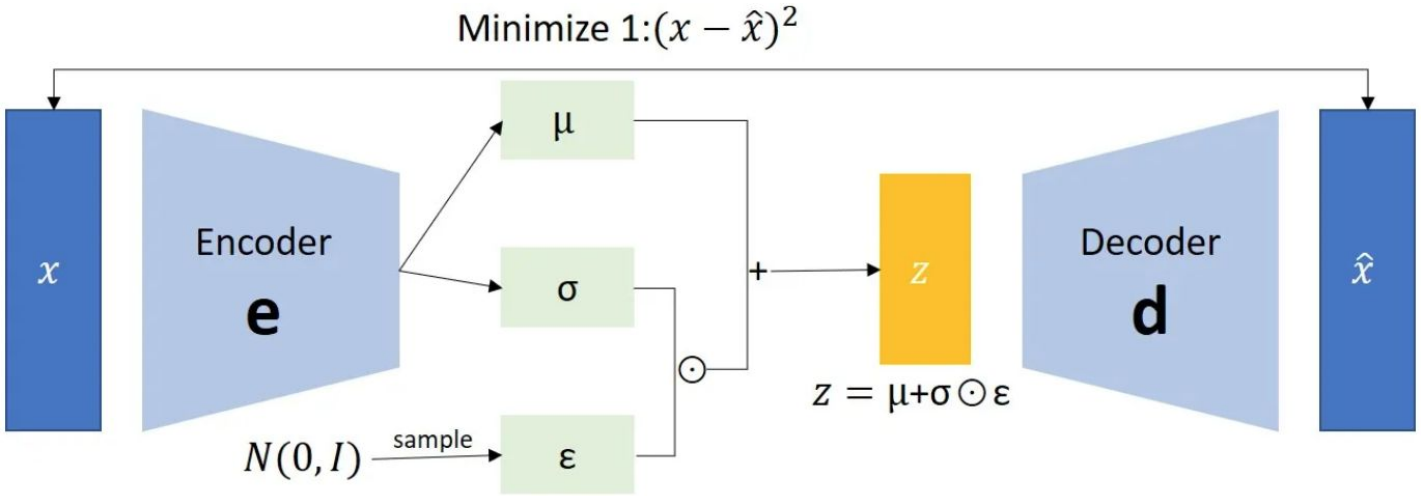
$e \approx 2.71828 \ldots$

VAE

- Proposed Kingma and Willing 2013



Loss of VAE



Minimize 2: $\frac{1}{2}\sum_{i=1}^{N}(\exp(\sigma_i) - (1+\sigma_i) + \mu_i{}^2)$

Code: https://keras.io/examples/generative/vae/