IT00DP82-3007
Artificial Intelligence and Machine Learning

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Example on using the internal representation - Autoencoder

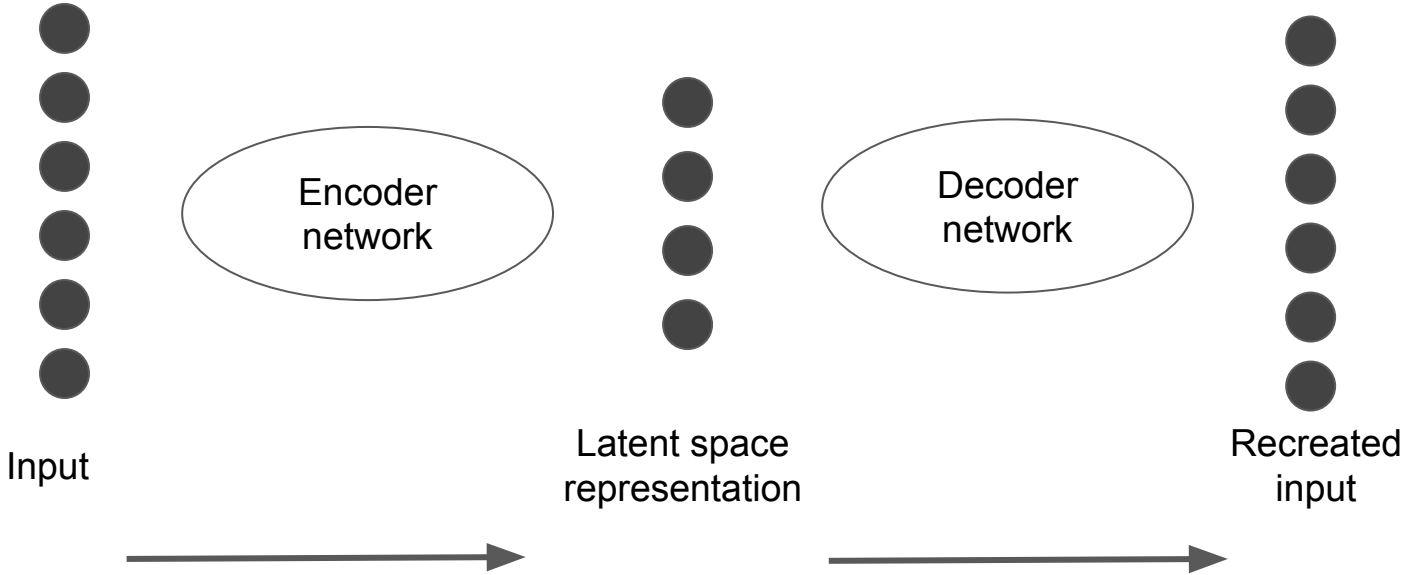
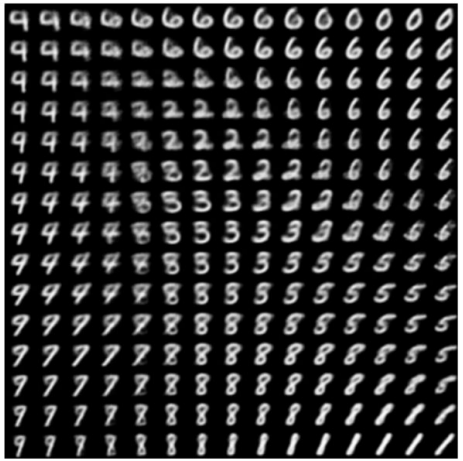


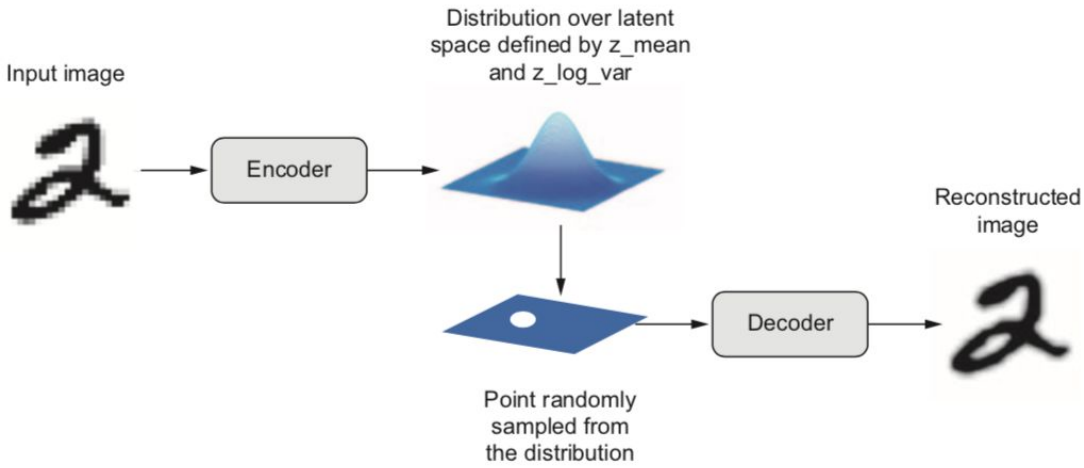
Image generation - variational autoencoder

Variational autoencoder takes the autoencoder idea further by

- Forcing the encoded (latent) space to be more **structured**
- Making the latent space more **continuous** - the space should not contain “gaps” that don’t have a mapping to reasonable image, and when moving a small distance in the latent space does not cause the mapped image to be drastically different



Variational autoencoder architecture



For Keras implementation, see 8.4-generating-images-with-vaes in book examples github.

Both the encoder and decoder are convnets that are trained with the same idea as an autoencoder - reconstructed image should match input image.

Variational: the encoded image representation fed into decoder is sampled from a point defined by the normal distribution with parameters z_mean and z_var. Even if the sample is not exactly at z_mean the target is to recreate the original image. This creates potentially useful structure in the latent space (which the plain autoencoder does not have).

Variational autoencoder and concept vectors

For some applications it is possible to identify concept vectors in the latent space. Concept vectors are added/subtracted from the latent representation and image in original space recreated →

Add (or remove) “smile” vector to/from images

Create fictional faces

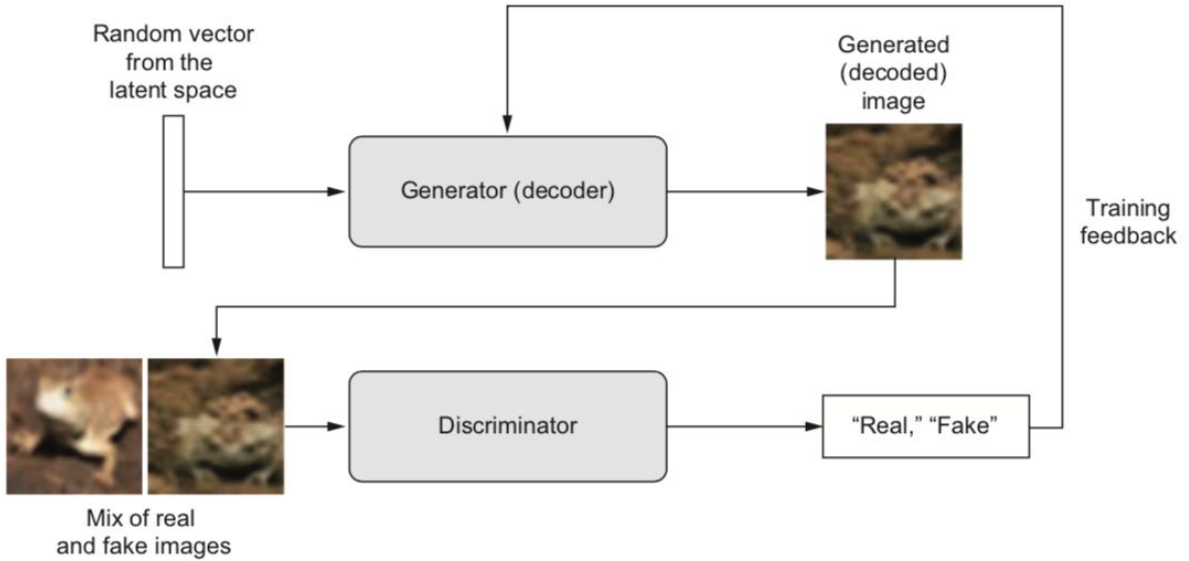
GAN (Generative Adversarial Network)

Same target as in VAEs (Variational Autoencoders) - learn a useful latent space (typically for images).

Two components:

- **Generative network**: generate a synthetic image based on random point in the latent space - aiming to learn to generate more and more real-looking images
- **Discriminator network (adversary or teacher)**: predict whether a given image is real (is taken from training set) or fake (is generated) - learn to detect fakes better and better

GAN architecture



Generated face faces based on CelebA images dataset. See https://research.nvidia.com/publication/2017-10_Progressive-Growing-of