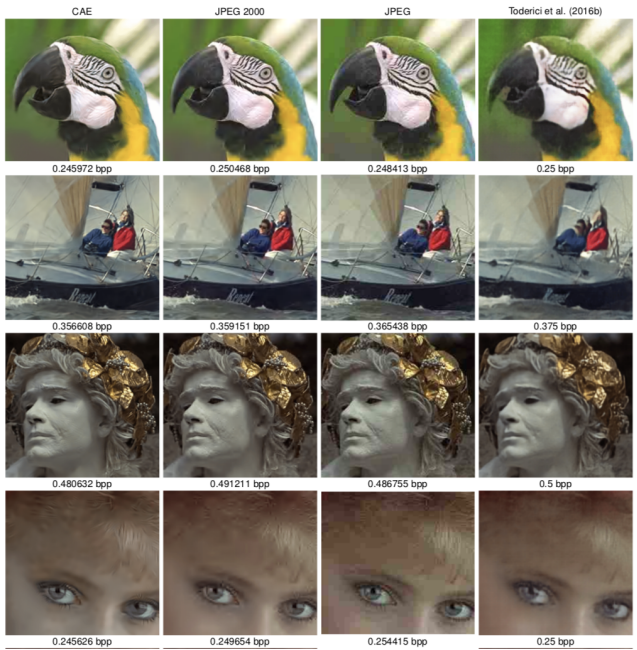
Deep Learning

Specific Autoencoders and Applications



Learning goals

- convolutional AEs
- applications of AEs

CONVOLUTIONAL AUTOENCODER (CONVAE)

- For the image domain, using convolutions is advantageous. Can we also make use of them in AEs?
- In a ConvAE, the encoder consists of convolutional layers. The decoder, on the other hand, consists of transpose convolution layers or simple upsampling operations.

CONVOLUTIONAL AUTOENCODER (CONVAE)

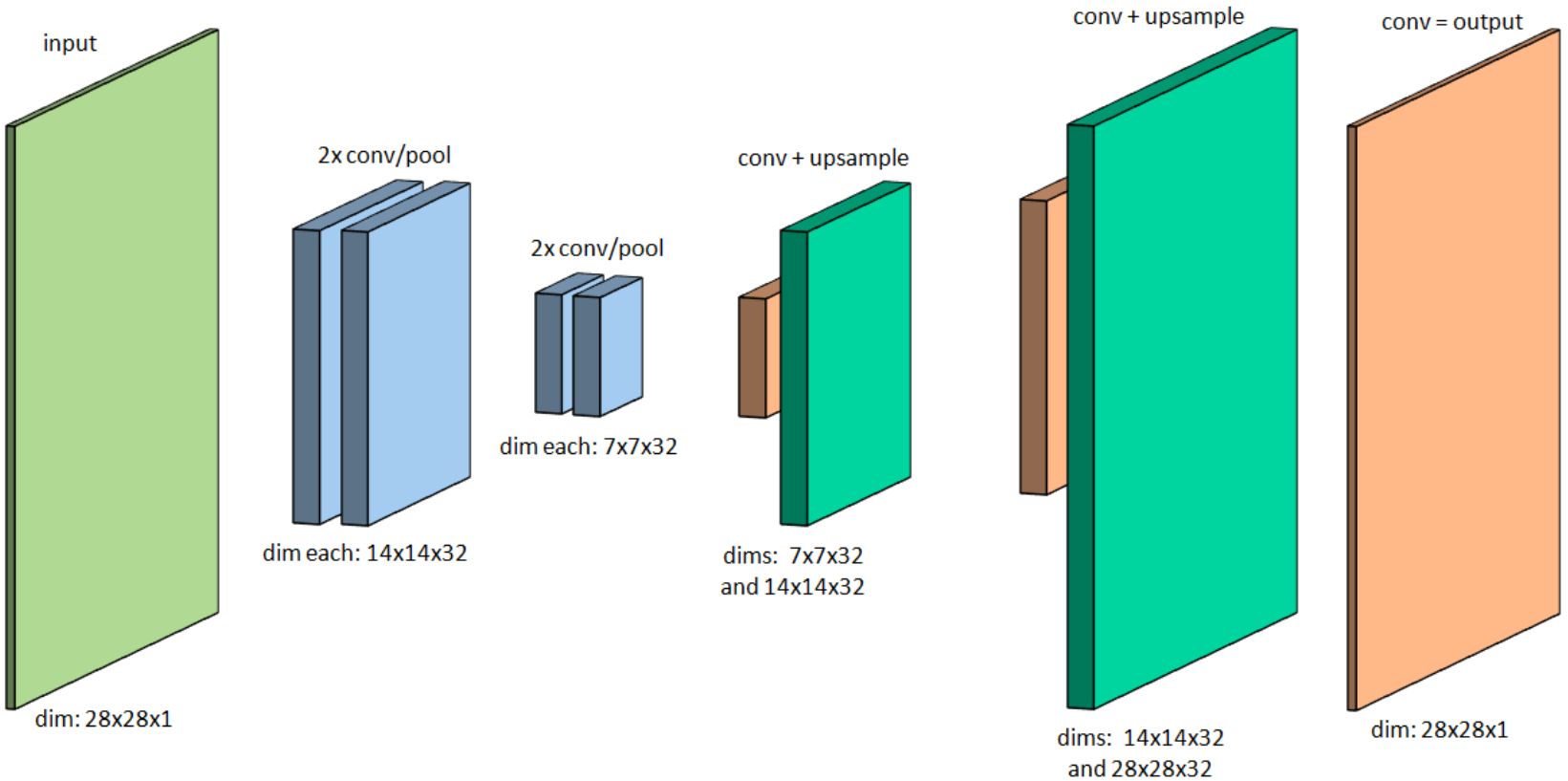


Figure: Potential architecture of a convolutional autoencoder.

We now apply this architecture to denoise MNIST.

CONVOLUTIONAL AUTOENCODER (CONVAE)

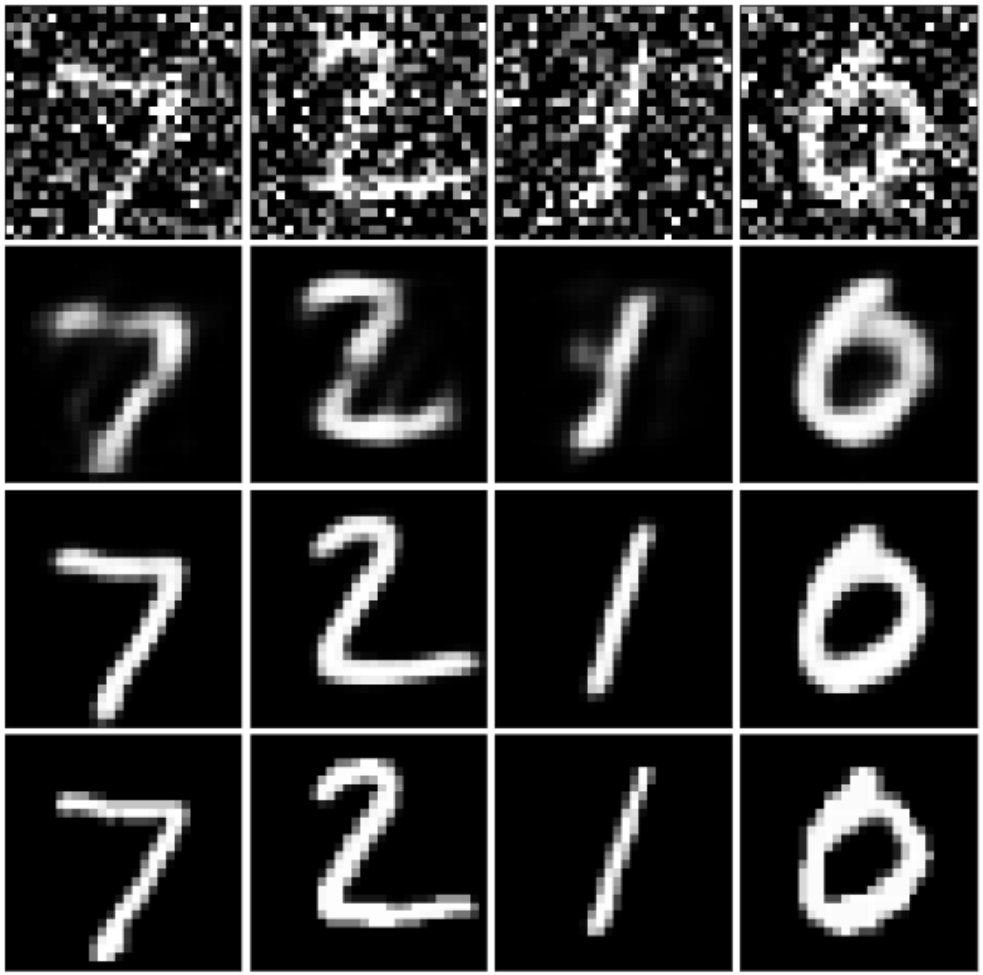


Figure: Top row: noised data, second row: AE with $dim(\boldsymbol{z}) = 32$ (roughly 50k params), third row: ConvAE (roughly 25k params), fourth row: ground truth.

REAL-WORLD APPLICATIONS

Today, autoencoders are still used for tasks such as:

- data de-noising,
- compression,
- and dimensionality reduction for the purpose of visualization.

REAL-WORLD APPLICATIONS

Medical image denoising using convolutional denoising autoencoders.

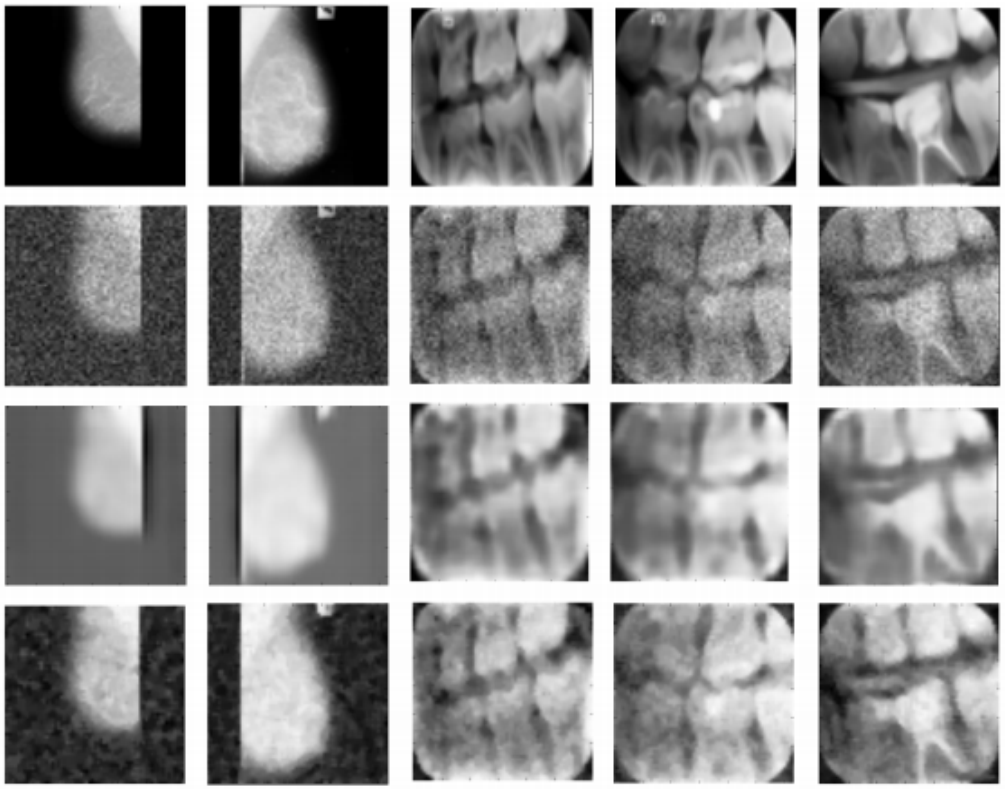


Figure: Top row: real image, second row: noisy version, third row: results of a (convolutional) denoising autoencoder and fourth row: results of a median filter (Gondara, 2016).

REAL-WORLD APPLICATIONS

AE-based **image compression**.

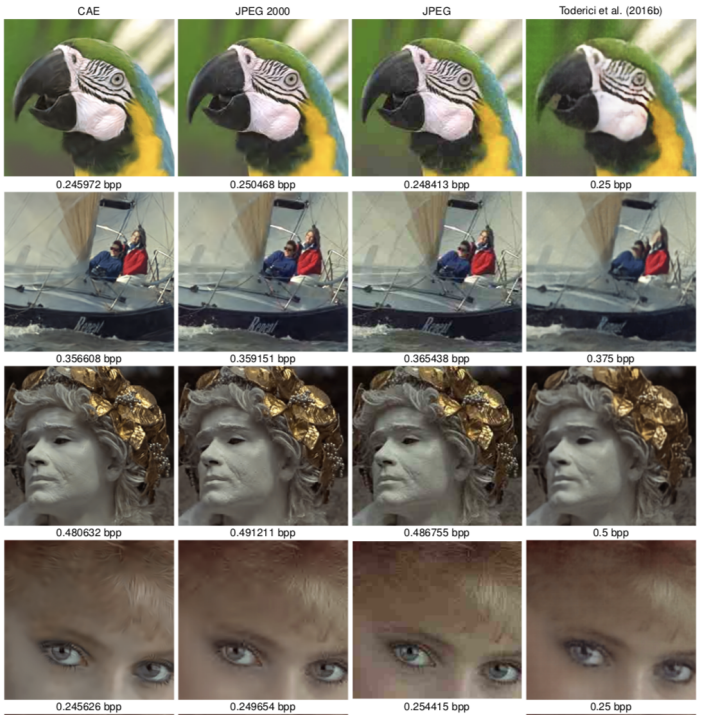


Figure: Closeups of images produced by different compression algorithms (Theis et al., 2017).

REFERENCES

Theis, L., Shi, W., Cunningham, A., & Huszár, F. (2017). *Lossy Image Compression with Compressive Autoencoders.*

Gondara, L. (2016). Medical Image Denoising Using Convolutional Denoising Autoencoders. *2016 IEEE 16th International Conference on Data Mining Workshops (ICDMW)*, 241–246. https://doi.org/10.1109/ICDMW.2016.0041