

Unsupervised learning

Prototyping with Deep Learning

Learning outcomes

After this lesson you will be able to:

- Identify unsupervised problems in DL
- Understand the autoencoder architecture
- Recognize applications of self-supervised learning

What is unsupervised learning?

Learn from data (e.g. structure, associations) without human supervision

Labeled data is a luxury!



<https://cloud.google.com/products/ai/ml-comic-1/>

Definitions

Unsupervised learning

No labeled data at all

Semi-supervised learning

Small amount of labeled data involved

Self-supervised learning

Labels are inferred from data

<https://medium.com/intuitionmachine/744a6819ce08>

<https://www.facebook.com/722677142/posts/10155934004262143/>

Some applications

Clustering

Dimensionality Reduction

Information Visualization

Learning Associative Rules

Anomaly Detection

Information Retrieval

Word Embeddings:

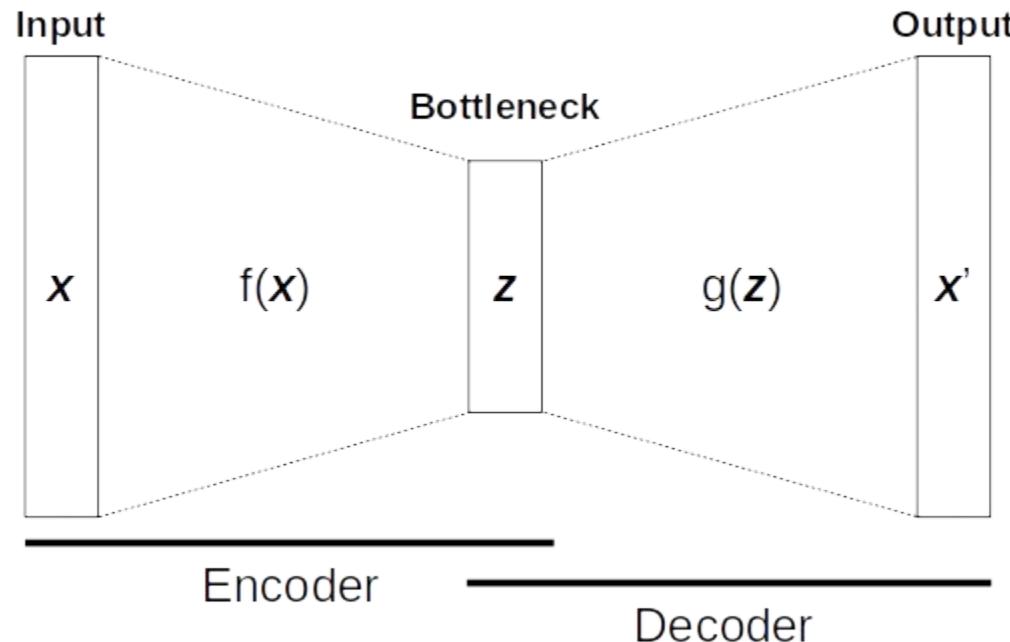
- CBOW
- Skip-gram

Image Enhancement:

- Noise removal
- Super-resolution
- Colorization

Autoencoders

$$\mathcal{L}(\mathbf{x}, \mathbf{x}') = [\mathbf{x} - g(f(\mathbf{x}))]^2$$



Latent variables

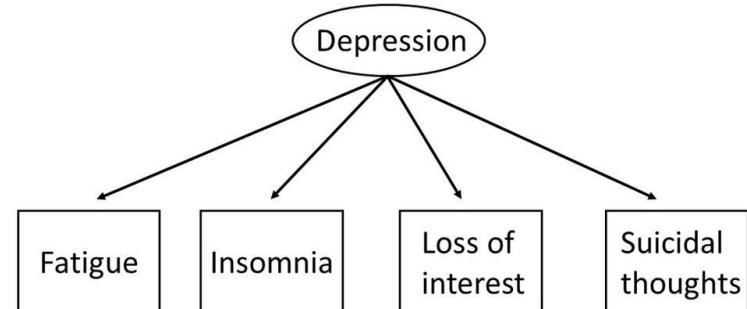
Are *implicit* data features

Cannot be observed or measured

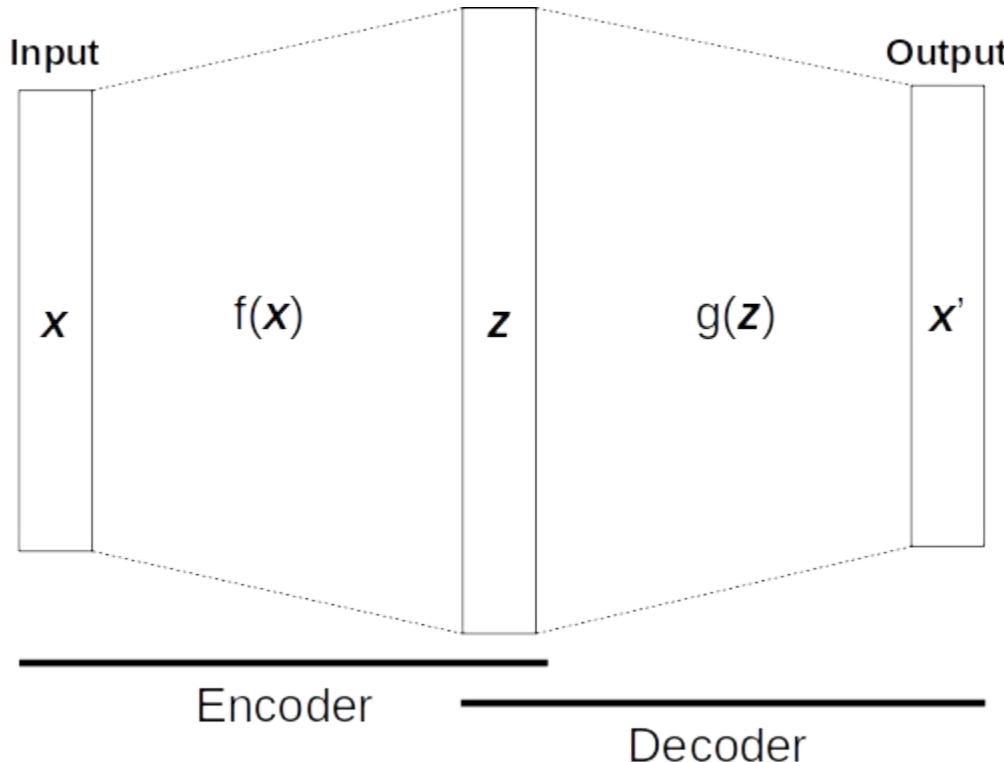
Are inferred from observable variables

Examples:

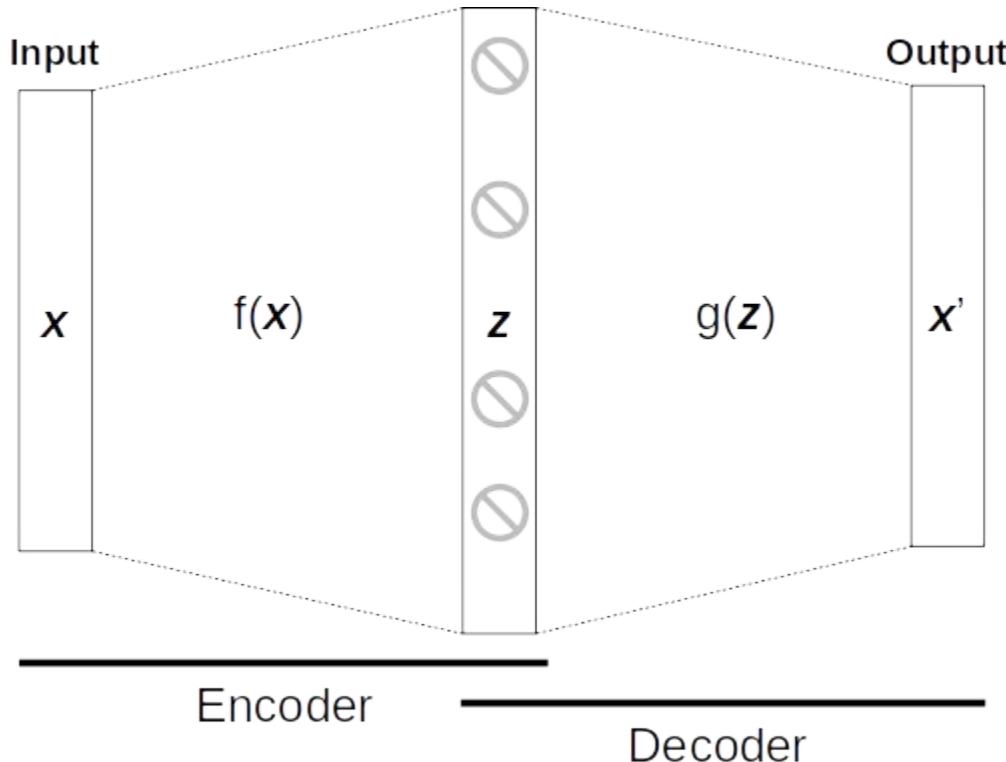
- Intelligence
- Motivation
- Depression



Overcomplete autoencoders

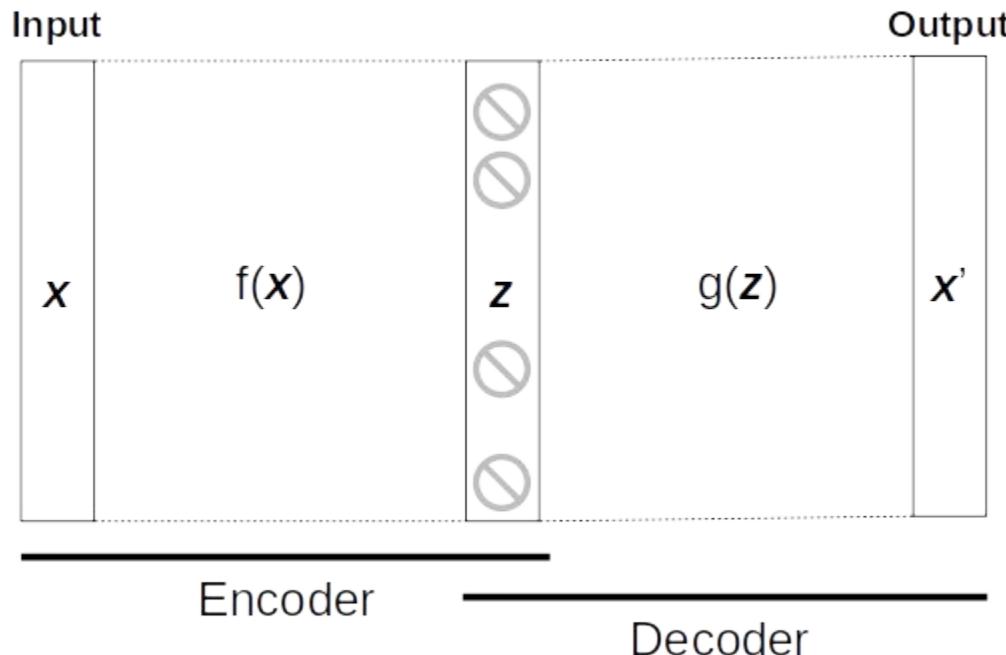


Overcomplete sparse autoencoders

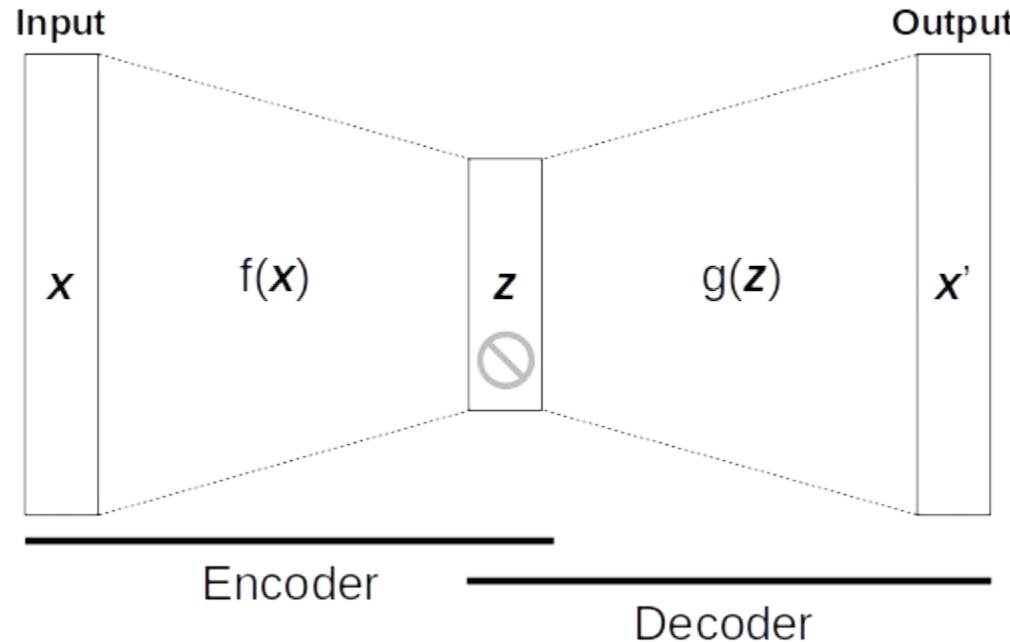


Sparse autoencoders

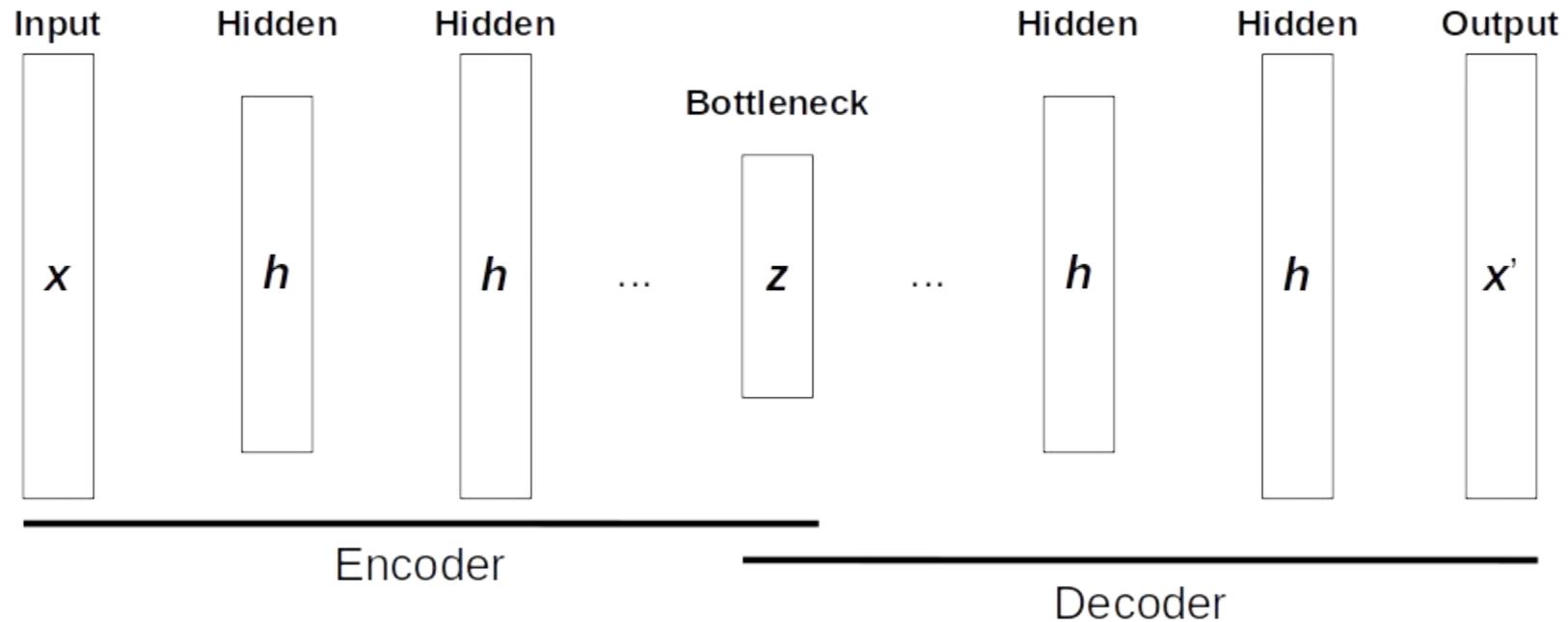
$$\mathcal{L}(\mathbf{x}, \mathbf{x}') = [\mathbf{x} - g(f(\mathbf{x}))]^2 + \Omega(\mathbf{z})$$



Undercomplete sparse autoencoders



Deep autoencoders



Contractive & Denoising AEs



Contractive

$f(x)$ robust to small perturbations

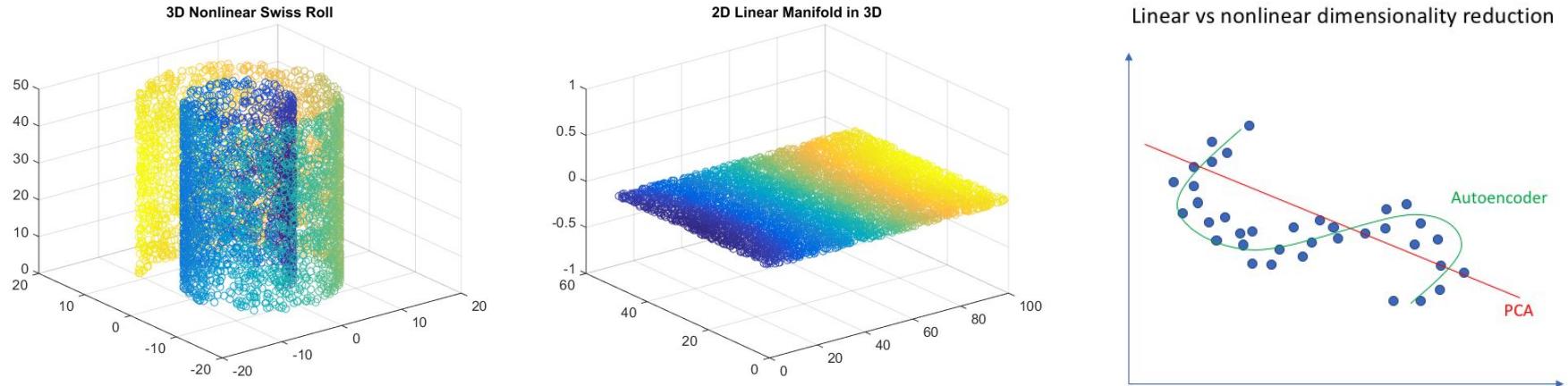
Resilient feature extraction (encoding)

Denoising

$g(z)$ robust to small perturbations

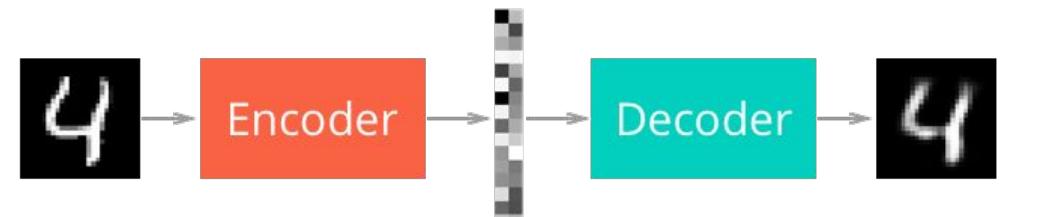
Resilient reconstruction (decoding)

Application: Dimensionality reduction

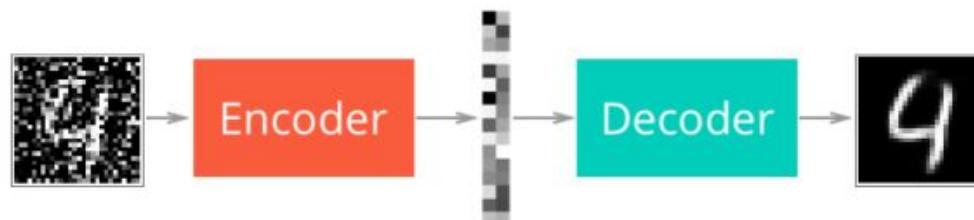


<https://www.jeremyjordan.me/autoencoders/>

Application: Noise removal

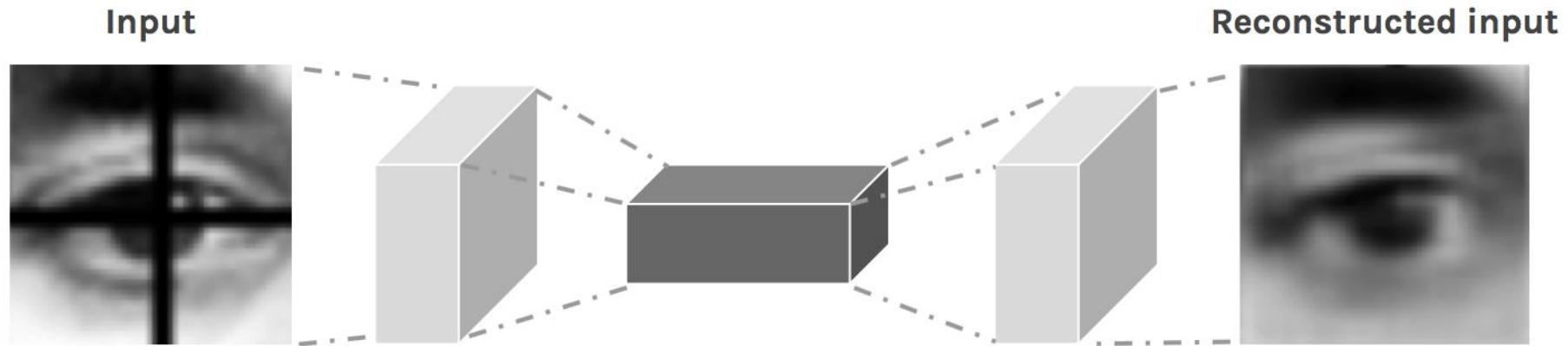


Original Compressed Reconstruction



Original Compressed Reconstruction

Application: Image inpainting



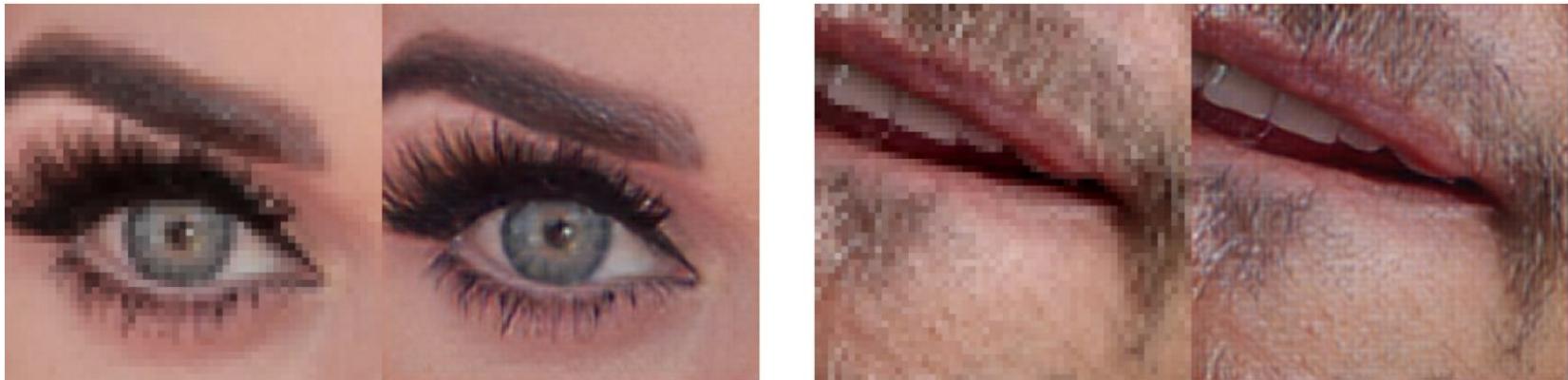
<https://hackernoon.com/autoencoders-deep-learning-bits-1-11731e200694>

Application: Image colorization



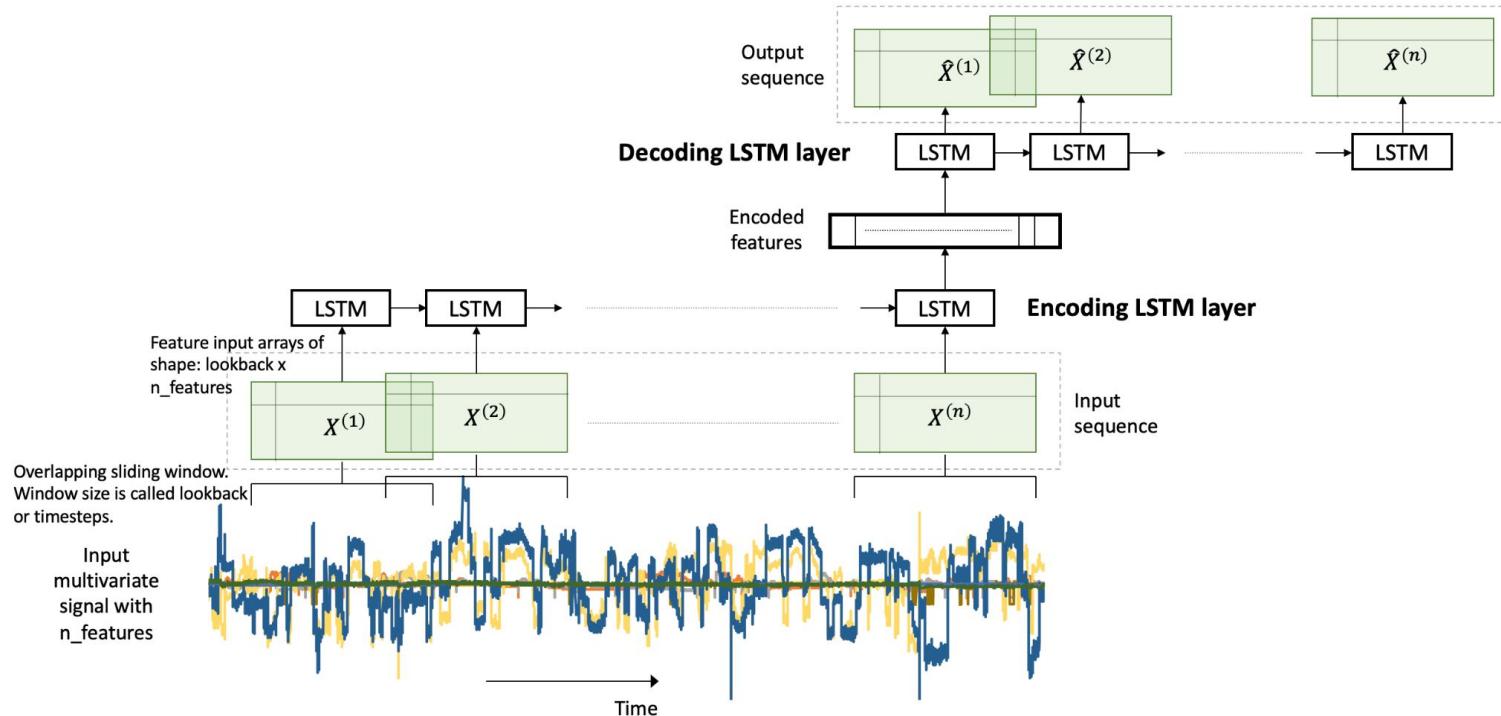
<https://medium.com/@mahmoudeljiddawi/a213b47f7339>

Application: Image super-resolution

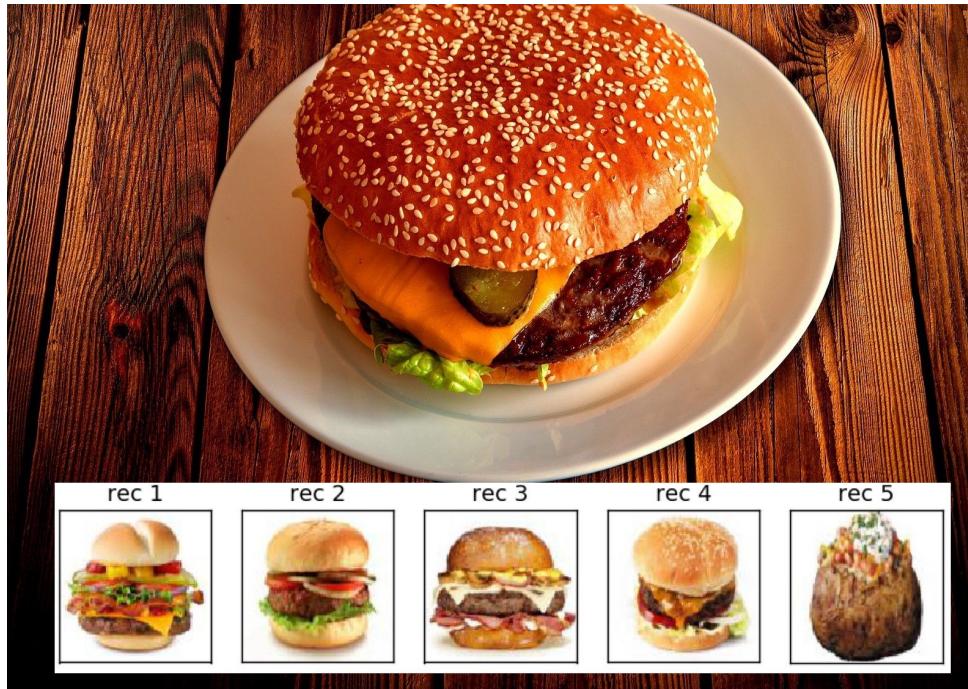


<https://hackernoon.com/autoencoders-deep-learning-bits-1-11731e200694>

Application: Anomaly detection



Application: Information retrieval



<https://towardsdatascience.com/315f374029ea>

Application: Recommender systems



recommendations

MovieLens helps you find movies you will like. Rate movies to build a custom taste profile, then MovieLens recommends other movies for you to watch.

top picks

based on your ratings, MovieLens recommends these movies



recent releases

movies released in last 90 days that you haven't rated



<https://nipunbatra.github.io/blog/ml/2017/12/18/recommend-keras.html>