Deep Learning 101

Autoencoder & GAN

Schedule

week	Date	Topic
9	10.27	Environment setup, python, Jupyter, PyCharm, TensorFlow, & regression
10	11.03	Training and testing
11	11.11	CNN
12	11.18	RNN
13	11.24	Word embedding & confusion matrix
14	12.01	Autoencoder & GAN

Today’s Class

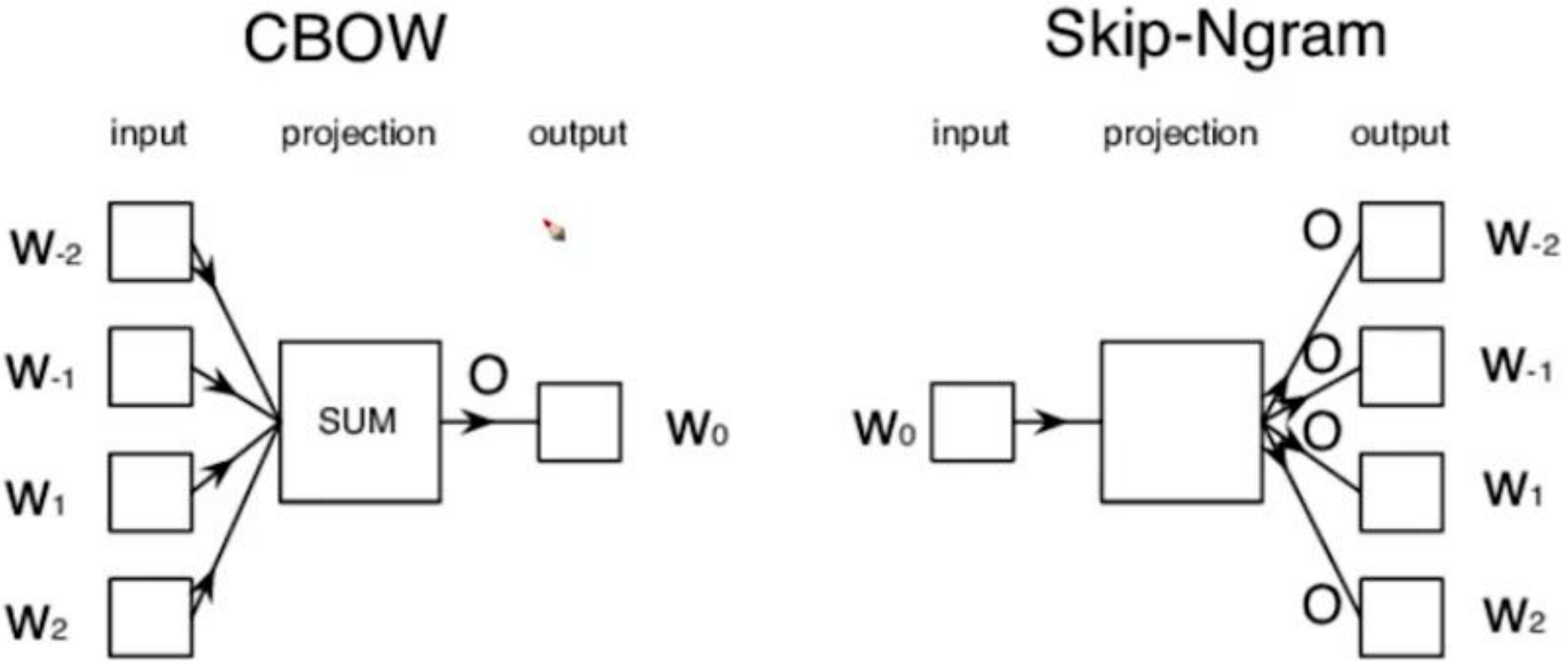
- Recap
- Autoencoder
- Variational Autoencoder
- GAN (Generative Adversarial Network)
- Lab time

Word Embedding Intuition

- “You shall know a word by the company it keeps.”
  - J. R. Firth (1957)

- Define a model that aims to predict between a center word w_t and context words in terms of word vectors. (Skip Gram)
  - $p(\text{context}|w_t)$
- Skip grams: Predict context words given target (position independent)
- Continuous Bag of Words (CBOW): Predict target word from bag-of-words context

Two models of word embedding

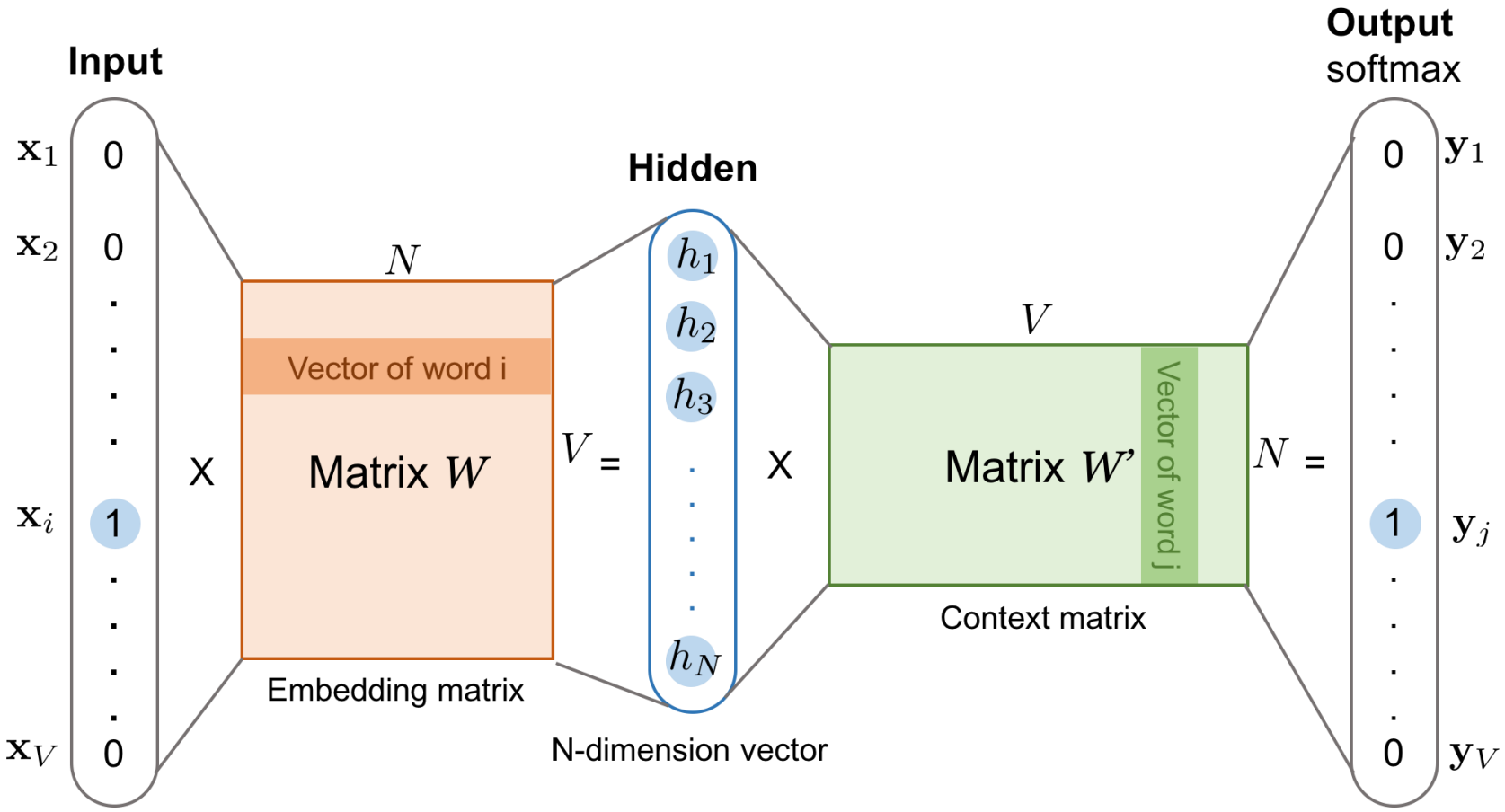


Word embeddings

king − man + woman ~= queen

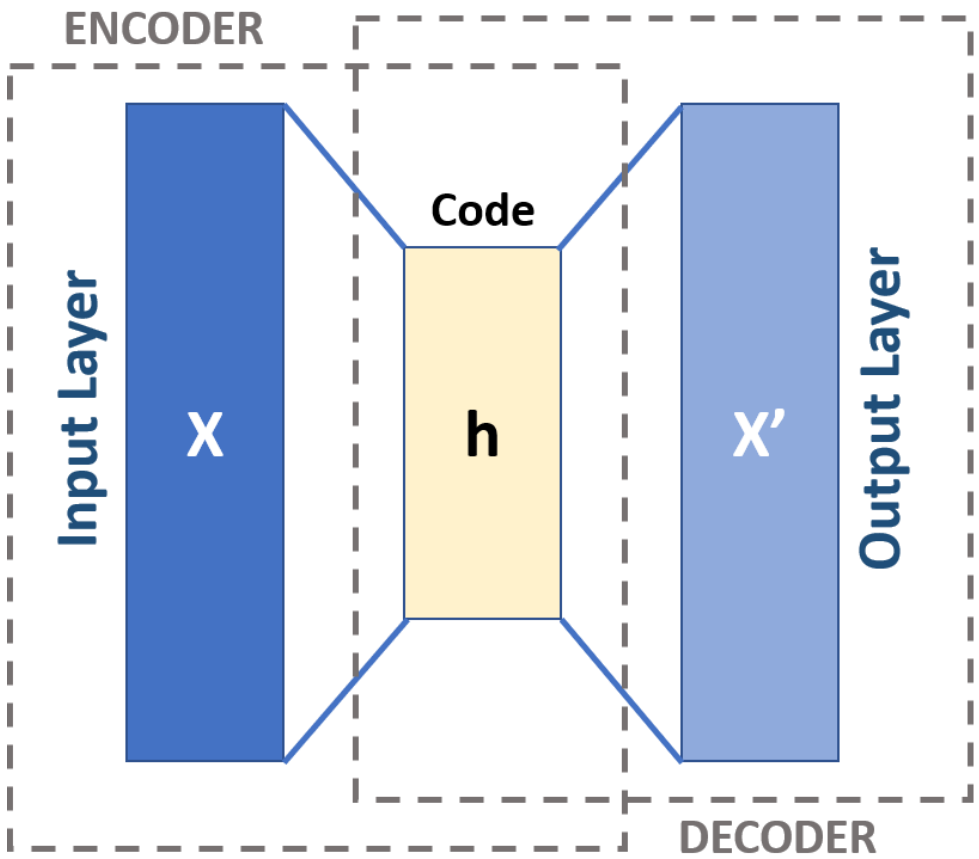
https://jalammar.github.io/illustrated-word2vec/

Word embedding is Encoder-Decoder Model



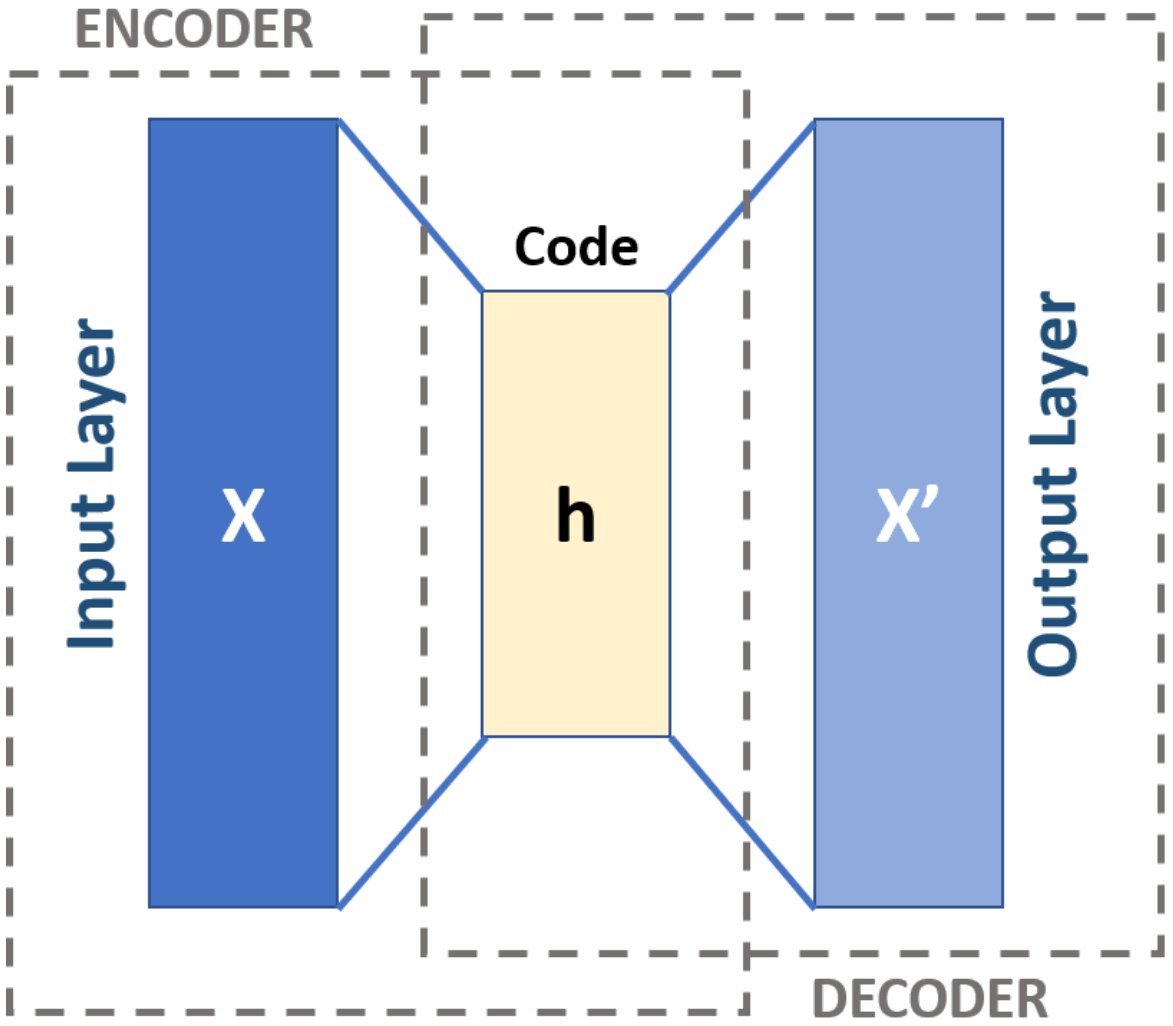
https://lilianweng.github.io/lil-log/2017/10/15/learning-word-embedding.html

Autoencoder - Encoder-Decoder Model



Autoencoder

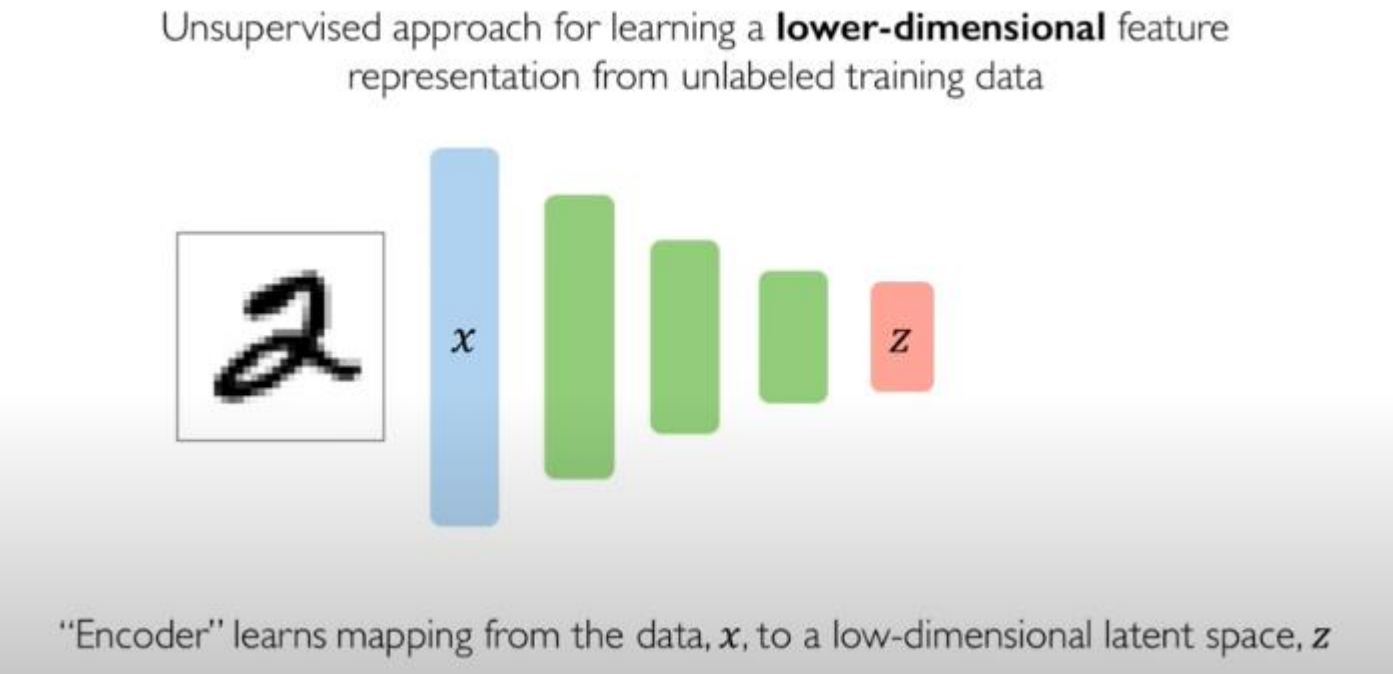
- Encoder – compresses
- Decoder - decompresses
- Unsupervised
  - Input (X) -> Reconstructed Input (X’)
- Deterministic



https://en.wikipedia.org/wiki/Autoencoder

Encoder

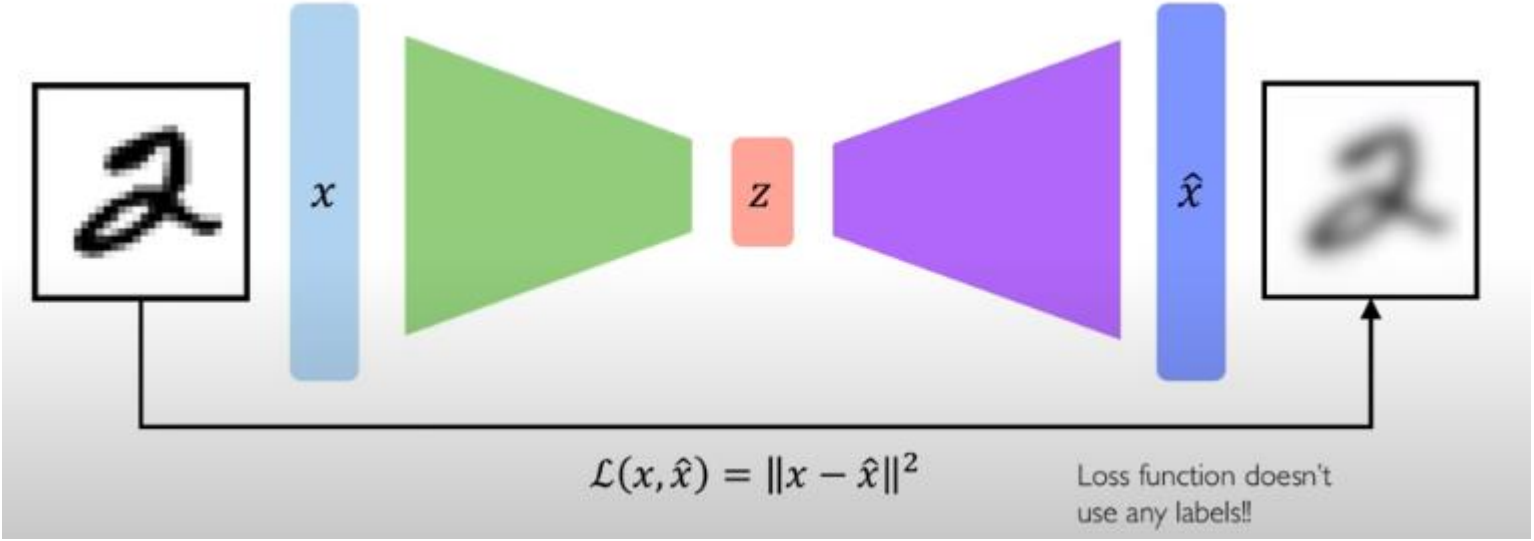
- Dimension reduction



http://introtodeeplearning.com/

Autoencoder

- Encoder-Decoder model
- Decoder decompressed the encoded information
- Ground Truth is the original image



http://introtodeeplearning.com/

Autoencoder –MNIST plot

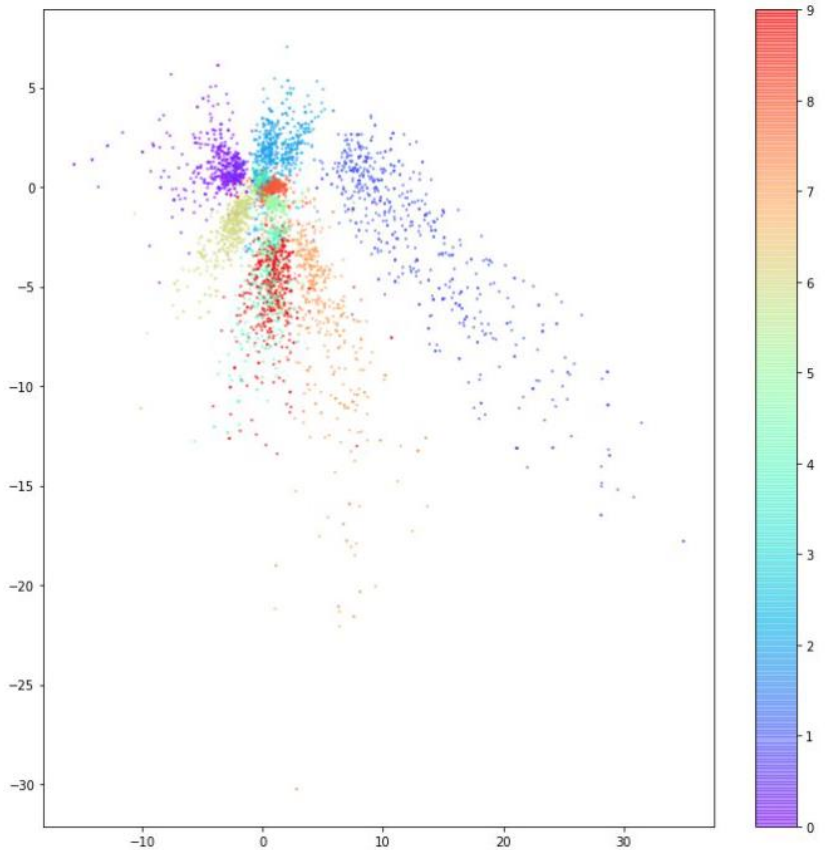
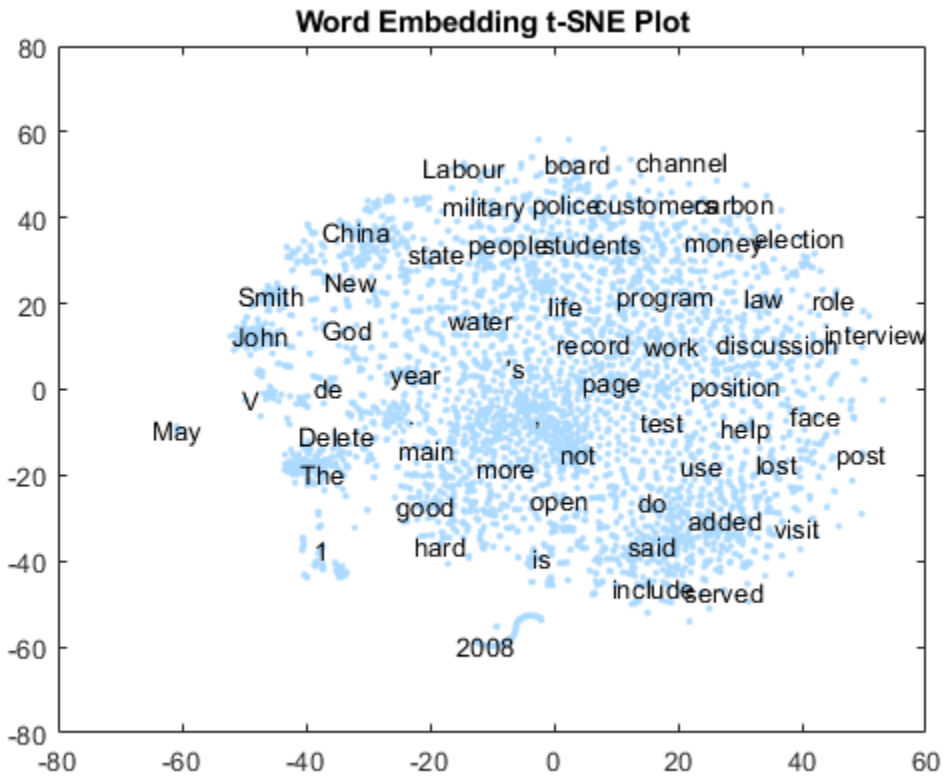


Figure 3-8. Plot of the latent space, colored by digit

David Foster (2019) Generative Deep Learning

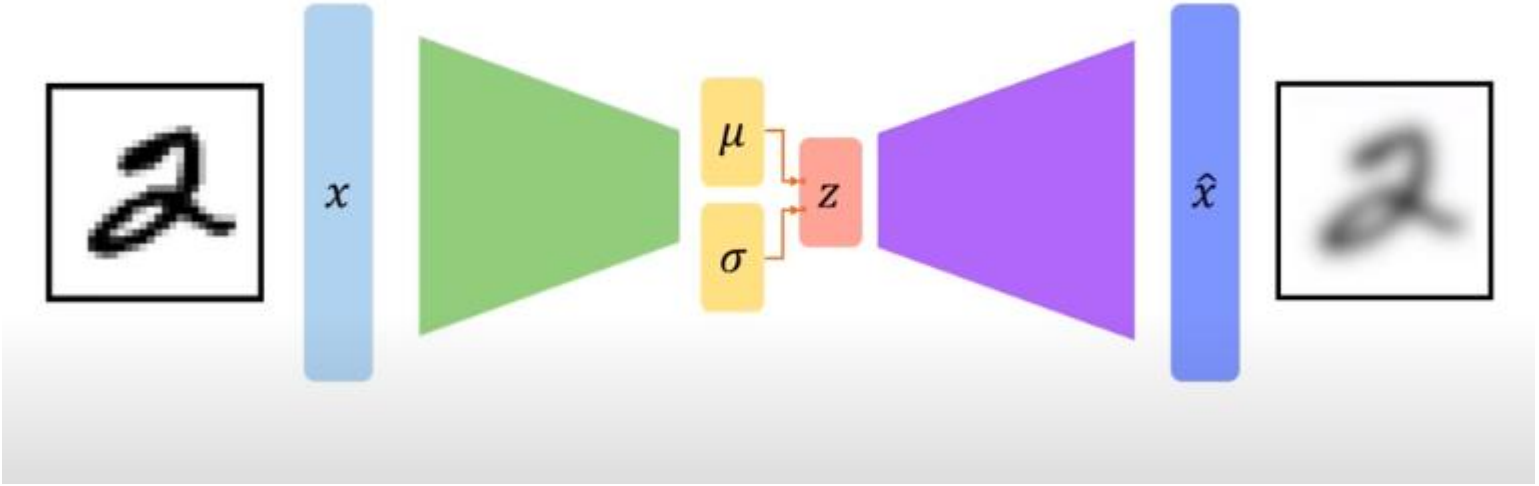
Word embedding plot



https://www.mathworks.com/help/textanalytics/ug/visualize-word-embedding-using-text-scatter-plot.html

Variational Autoencoder

- Autoencoder with probabilistic twist
- Generative – creates a new data by stochastic sampling operations
  - mean (mu)
  - variance (sigma – square root of standard deviation)
  - latent variable (z) - sampling



http://introtodeeplearning.com/

Autoencoder vs. Variational Autoencoder

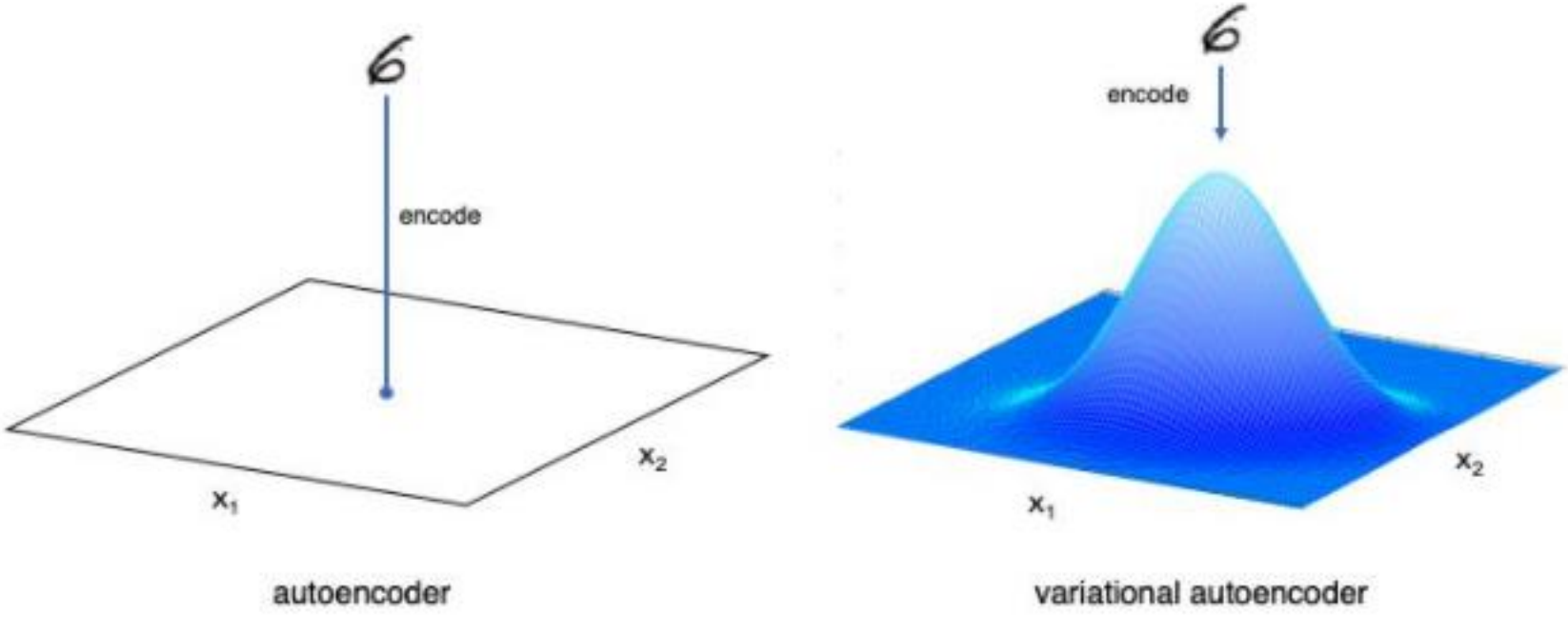
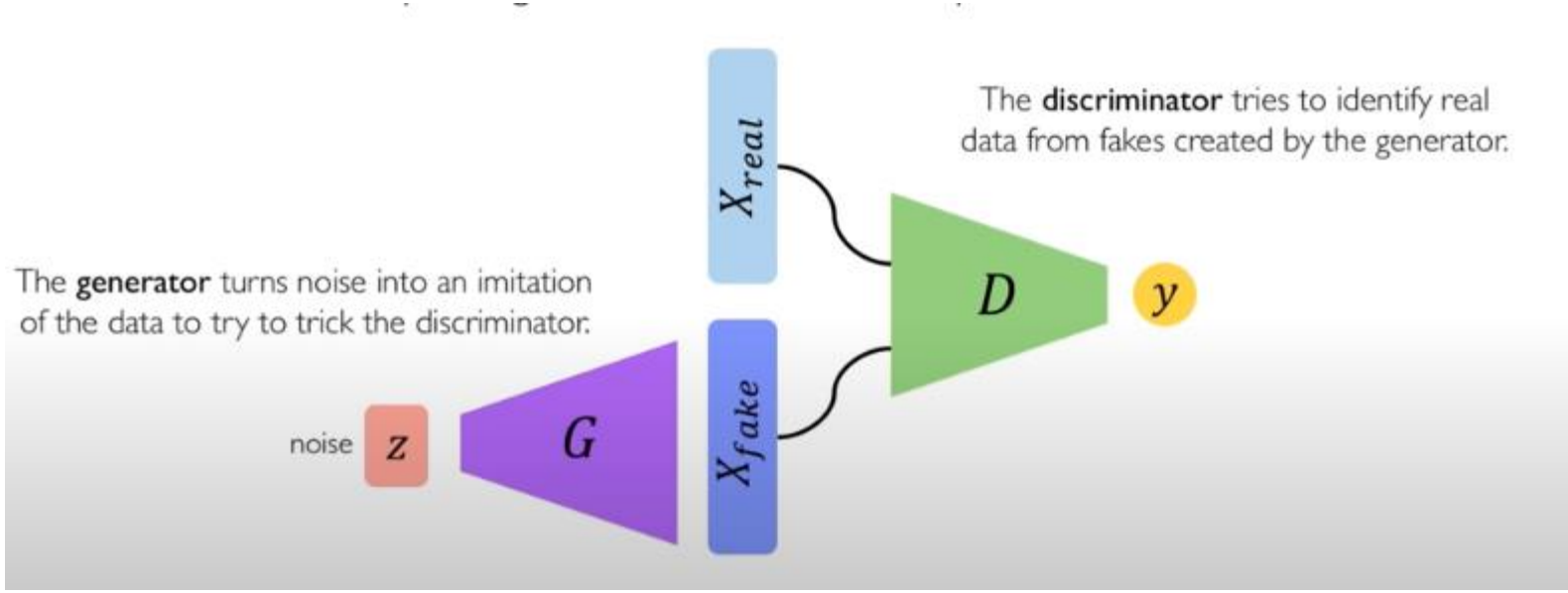


Figure 3-11. The difference between the encoder in an autoencoder and a variational autoencoder

David Foster (2019) Generative Deep Learning

GAN (Generative Adversarial Network)

- Two competing networks
  - Generator: generates fake images (VAE)
  - Discriminator: classifies whether an image is real or not



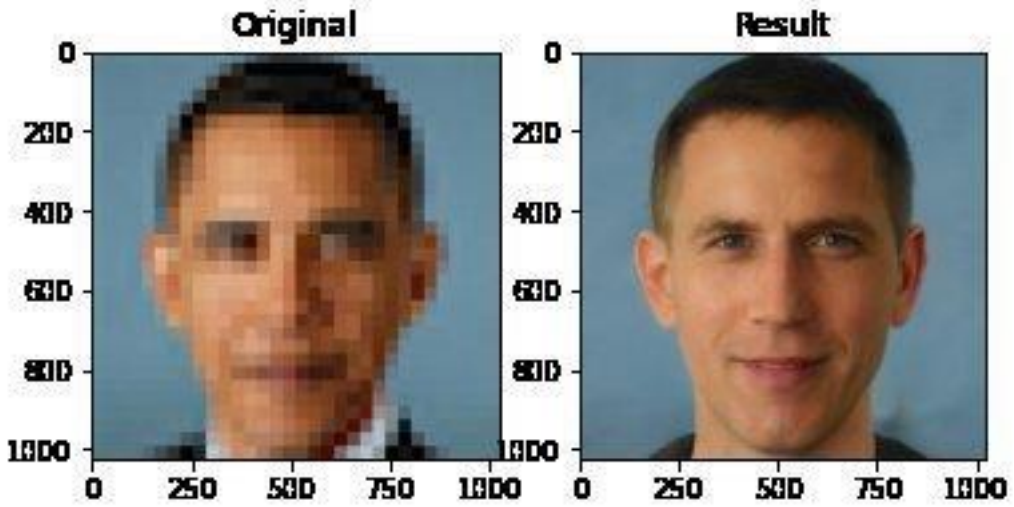
Applications

- Image compression and restoration
- Denoising
- Image generation: text, video, sound, etc.
- StyleGAN, CartoonGAN
- Deepfake?

https://en.wikipedia.org/wiki/Deepfake

Problems with bias (again)

- Why is Obama reconstructed as a Caucasian?



https://twitter.com/Chicken3gg/status/1274314622447820801

Lab time

- To clone: from your terminal
  - >git clone https://github.com/changsin/DeepLearning-101.git
- Or use google colab to point to the git hub repository
- Git is an open source version control system
  - Github is a host service using git.

What is the next step?

- What did you learn?
- What do you know about AI, Machine Learning, & Deep Learning now?
  1. I don’t know what I don’t know.
  2. I know that I don’t know.
  3. I know everything
- Keep asking, keep learning

- “Know the truth and the truth shall set you free” (John 8:32)