
# Special Topics: MODERN METHODS

PHYS 453

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# Modern Methods

- A very brief survey of some recent hot topics in ML
- No particular order

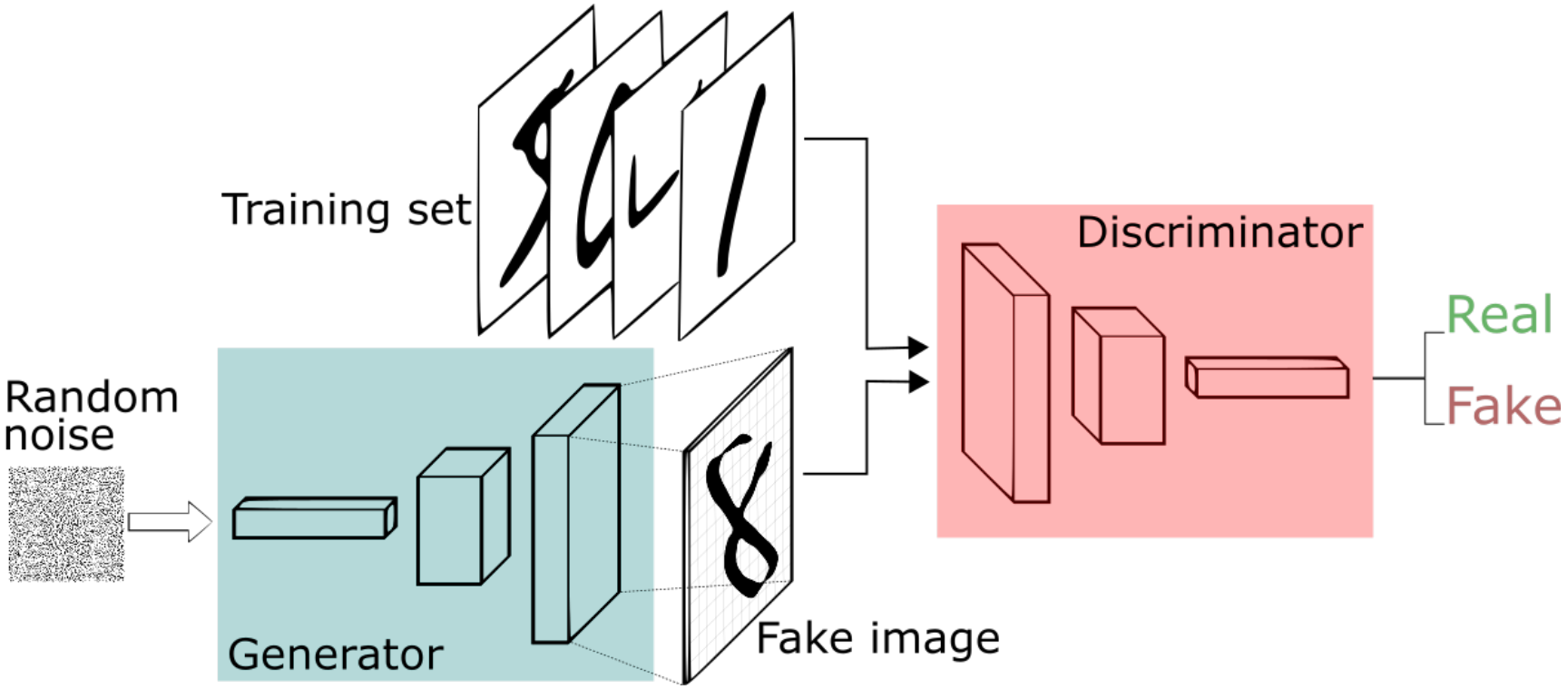
# GANS

https://arxiv.org/abs/1710.10196

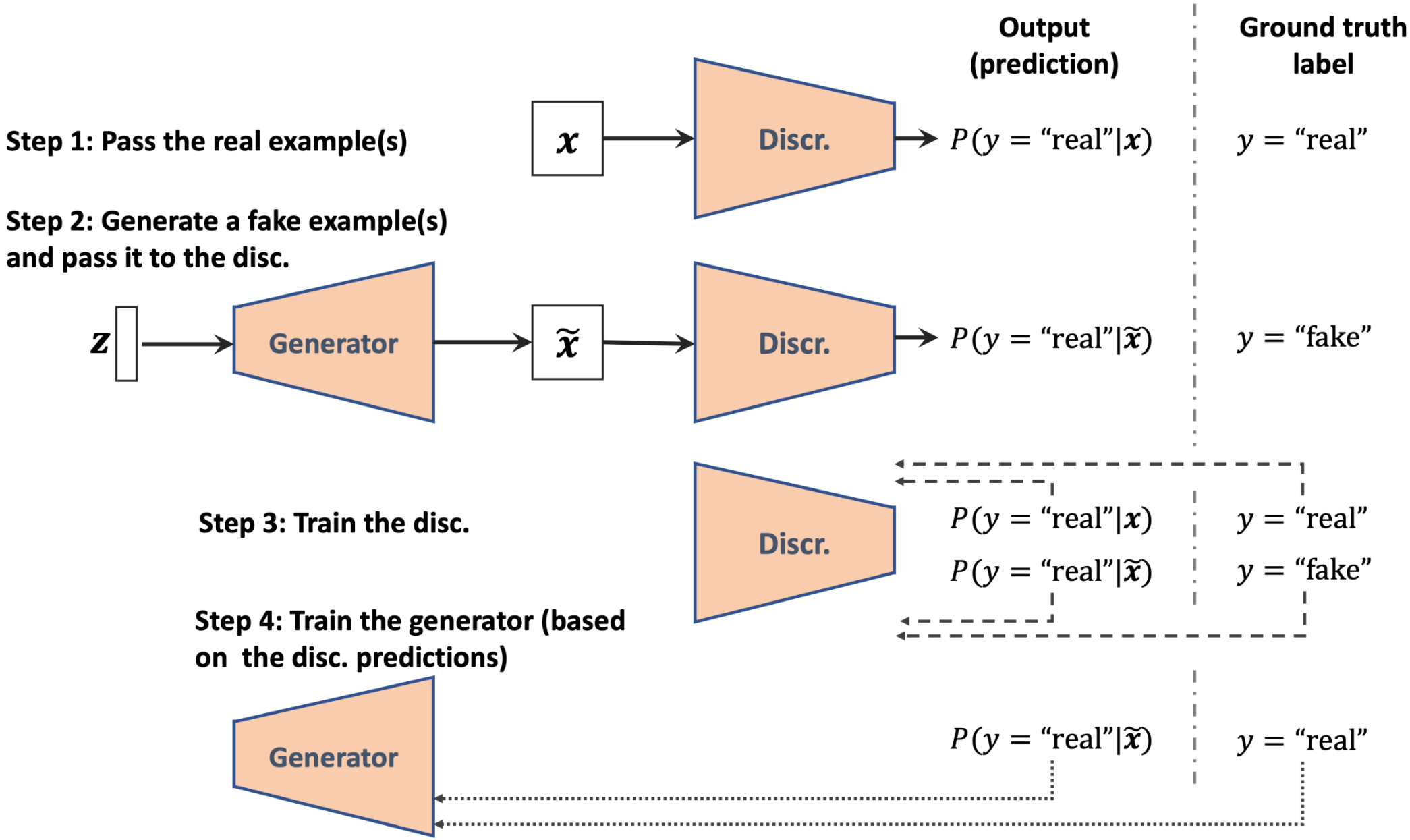
# NONE OF THESE PEOPLE ARE REAL

# Generative Adversarial Networks

- Very clever trick to generate realistic data
- Proposed in 2014 - https://arxiv.org/abs/1406.2661
- Create a generator and a discriminator that learn from each other and improve together



https://github.com/rasbt/machine-learning-book/blob/main/ch17/ch17_part1.ipynb



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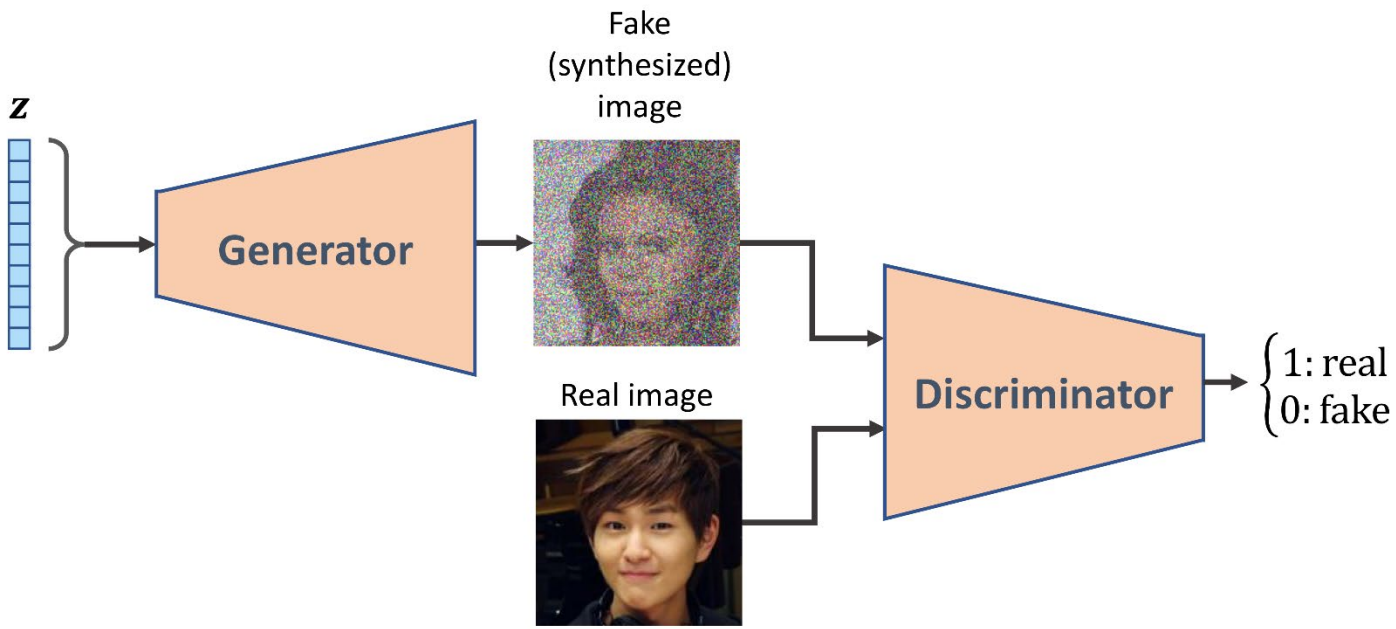
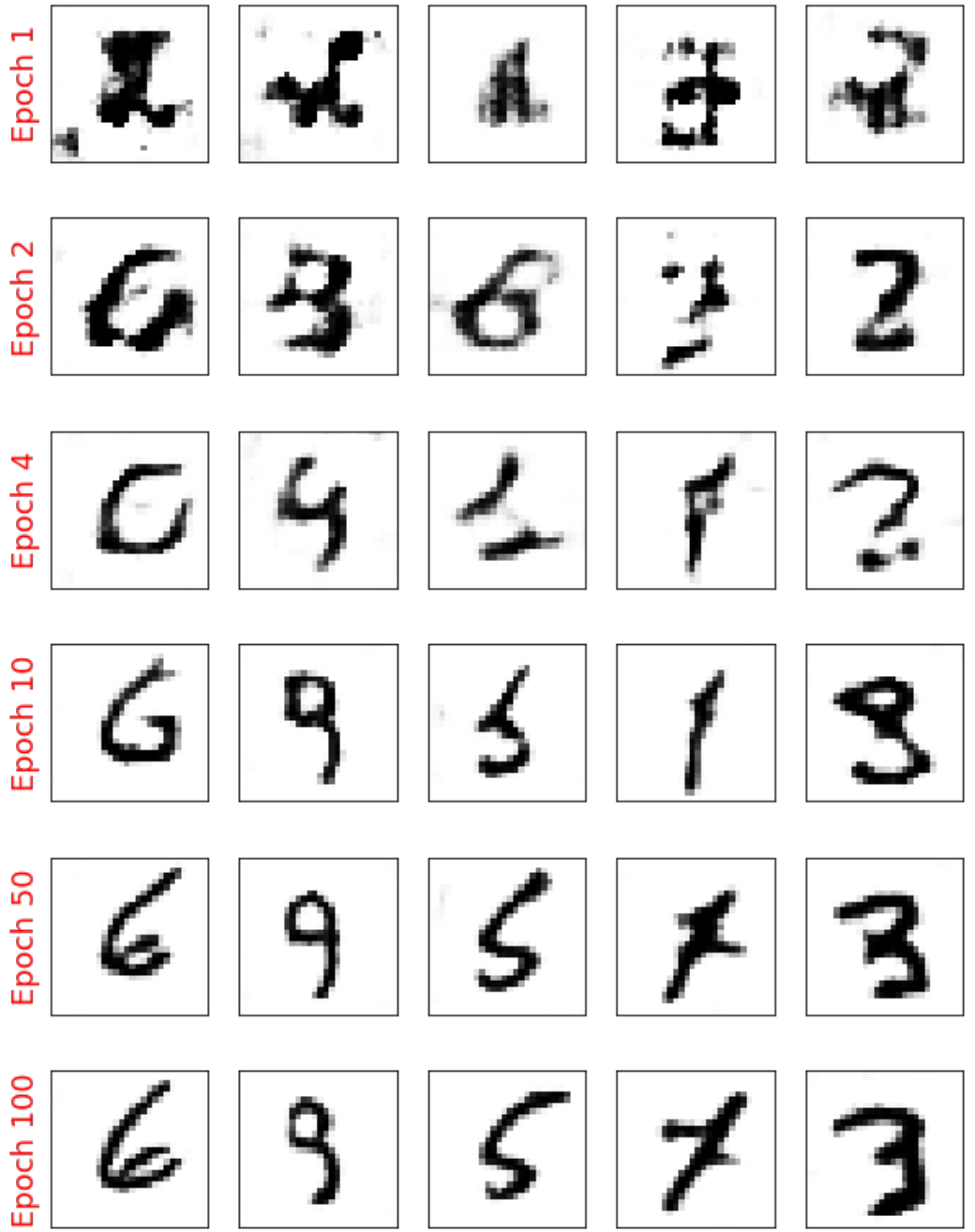


# Generative Adversarial Networks

Resources

- https://arxiv.org/abs/1406.2661
- https://en.wikipedia.org/wiki/Generative_adversarial_network
- https://machinelearningmastery.com/what-are-generative-adversarial-networks-gans/
- https://github.com/rasbt/machine-learning-book/blob/main/ch17/ch17_part1.ipynb

# DEEP NEURAL NETWORKS

https://scikit-learn.org/stable/modules/neural_networks_supervised.html

# 1.17. Neural network models (supervised)

**Warning:** This implementation is not intended for large-scale applications. In particular, scikit-learn offers no GPU support. For much faster, GPU-based implementations, as well as frameworks offering much more flexibility to build deep learning architectures, see Related Projects.

What to use instead:

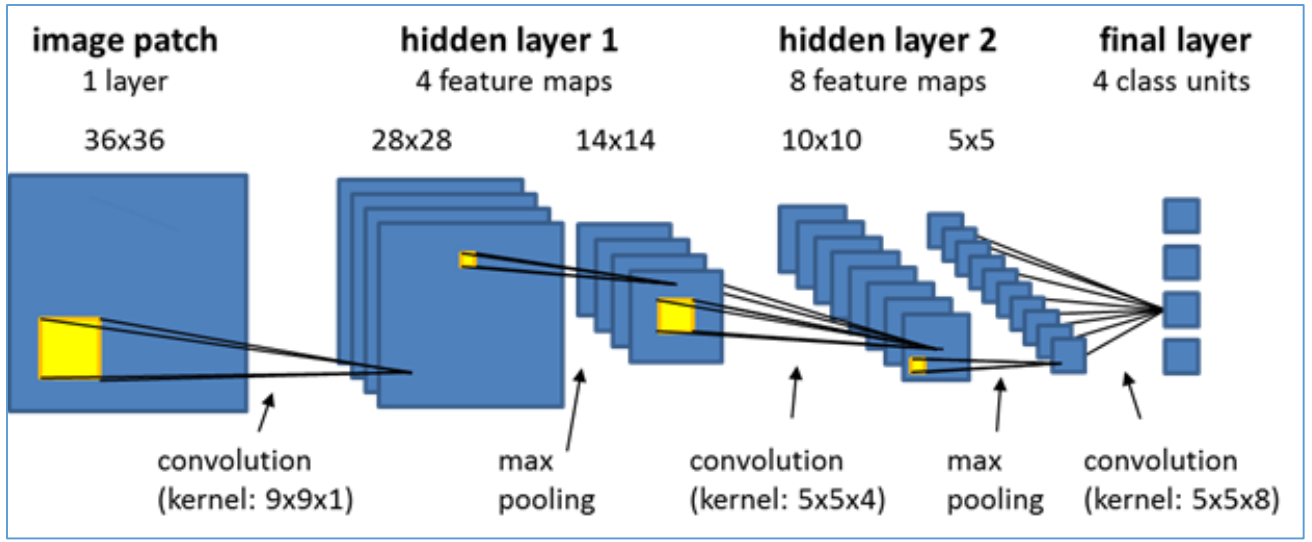
- https://pytorch.org/ optionally with https://github.com/skorch-dev/skorch
- https://www.tensorflow.org/ optionally with https://keras.io/

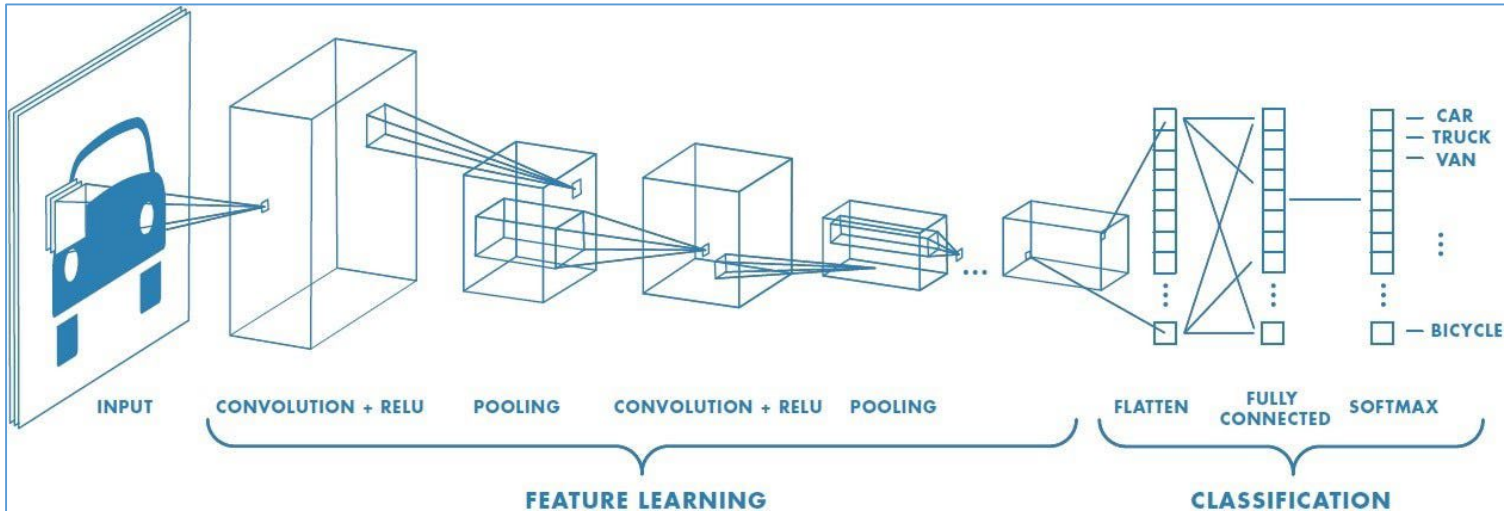
Advantages

- Designed to run on GPU farms
- Flexible deep NNs with ever-growing list of tools

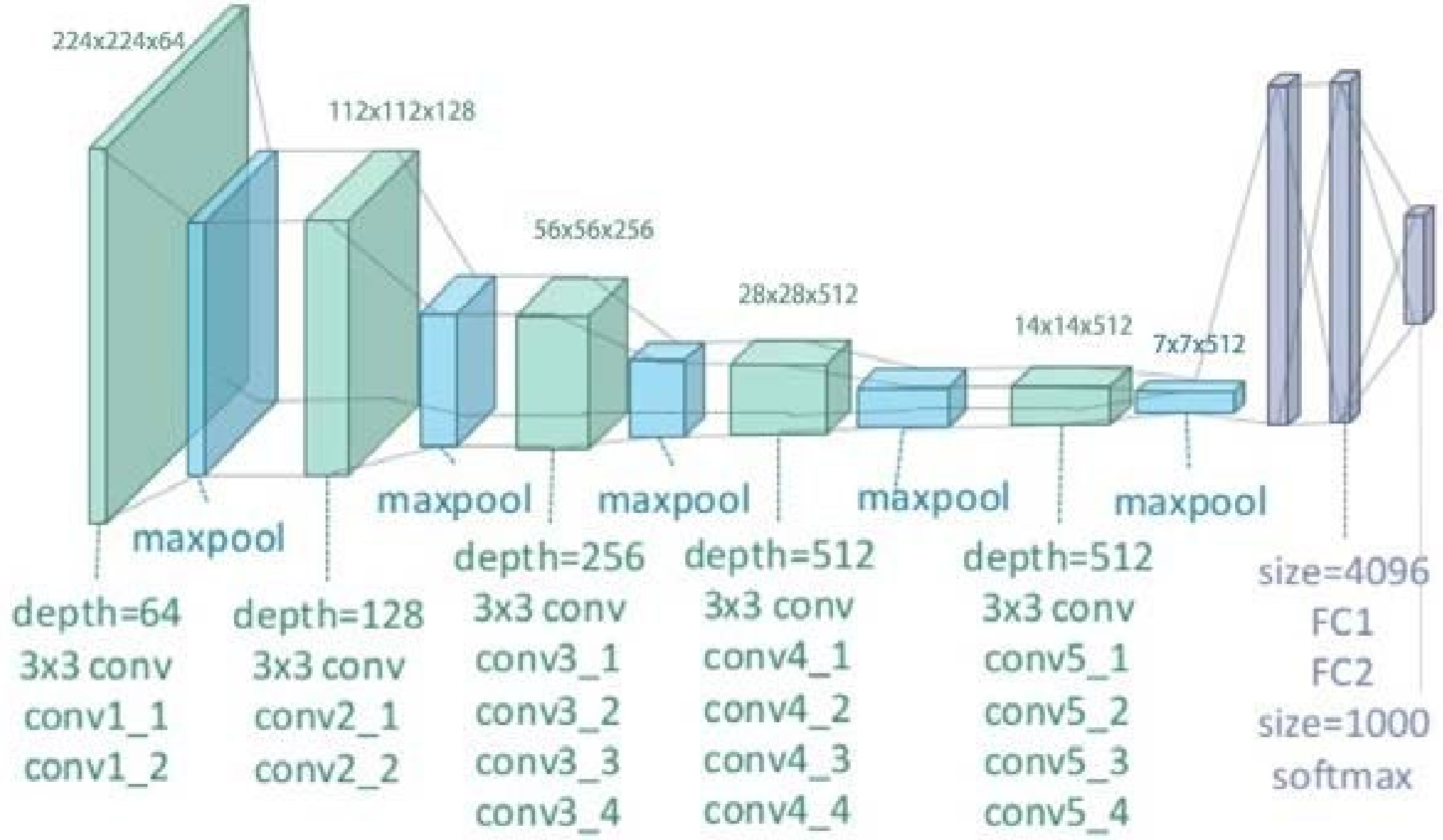
# Example: CNN

- Convolution: imagine a sliding window that moves across pixels
- Main application is computer vision, need model to match symmetries of our problem. For a picture of a bird, the bird can be anywhere in the picture, so a convolution gives a direct way to handle images
- Pooling: reduce dimension by combining inputs from previous layer



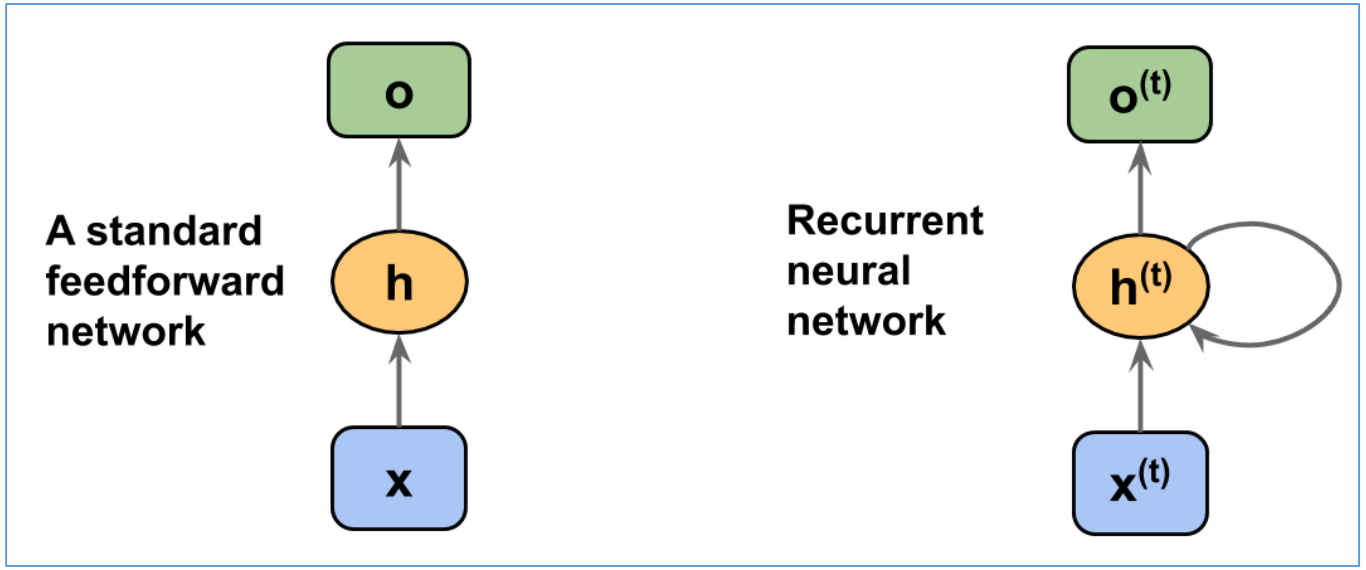



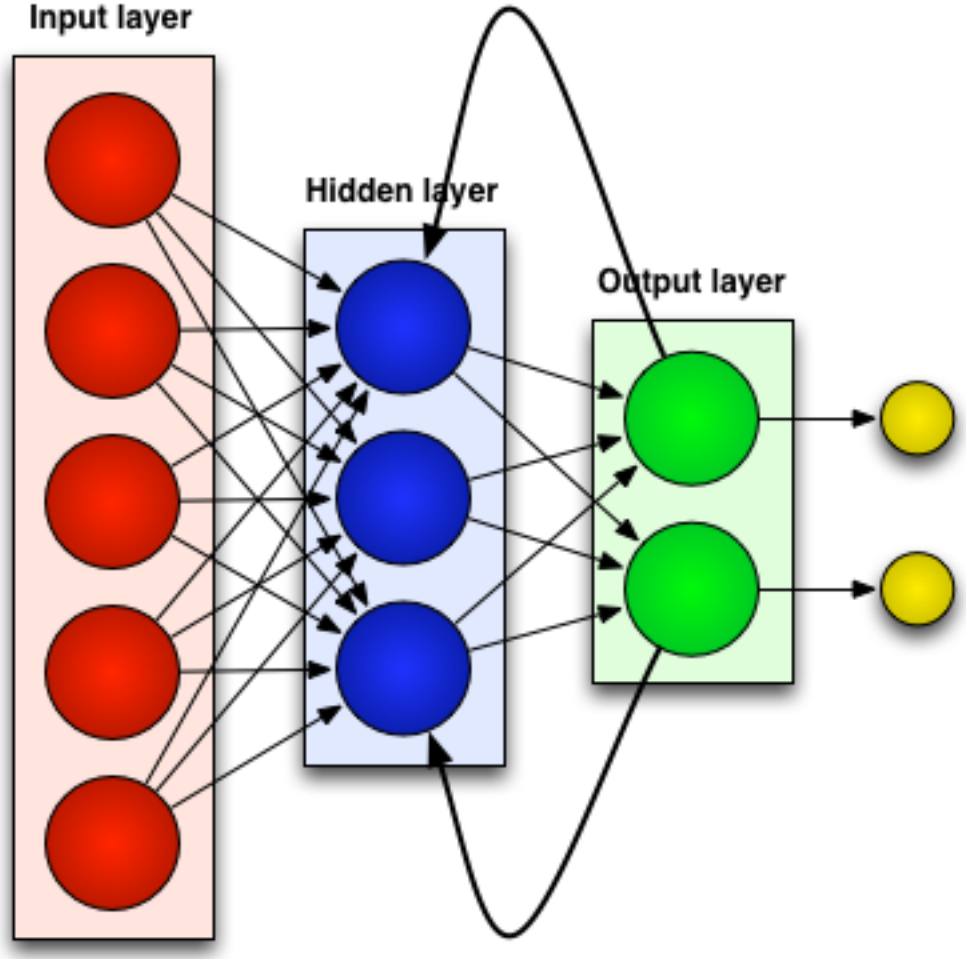
https://colab.research.google.com/github/tensorflow/models/blob/master/research/nst_blogpost/4_Neural_Style_Transfer_with_Eager_Execution.ipynb



## Recurrent Neural Network

- Adds limited “short term memory” to NN
- Allows for context in classifiers
- https://en.wikipedia.org/wiki/Recurrent_neural_network



# Deep Learning

## Resources

- https://en.wikipedia.org/wiki/Deep_learning
- https://keras.io/
- https://github.com/skorch-dev/skorch

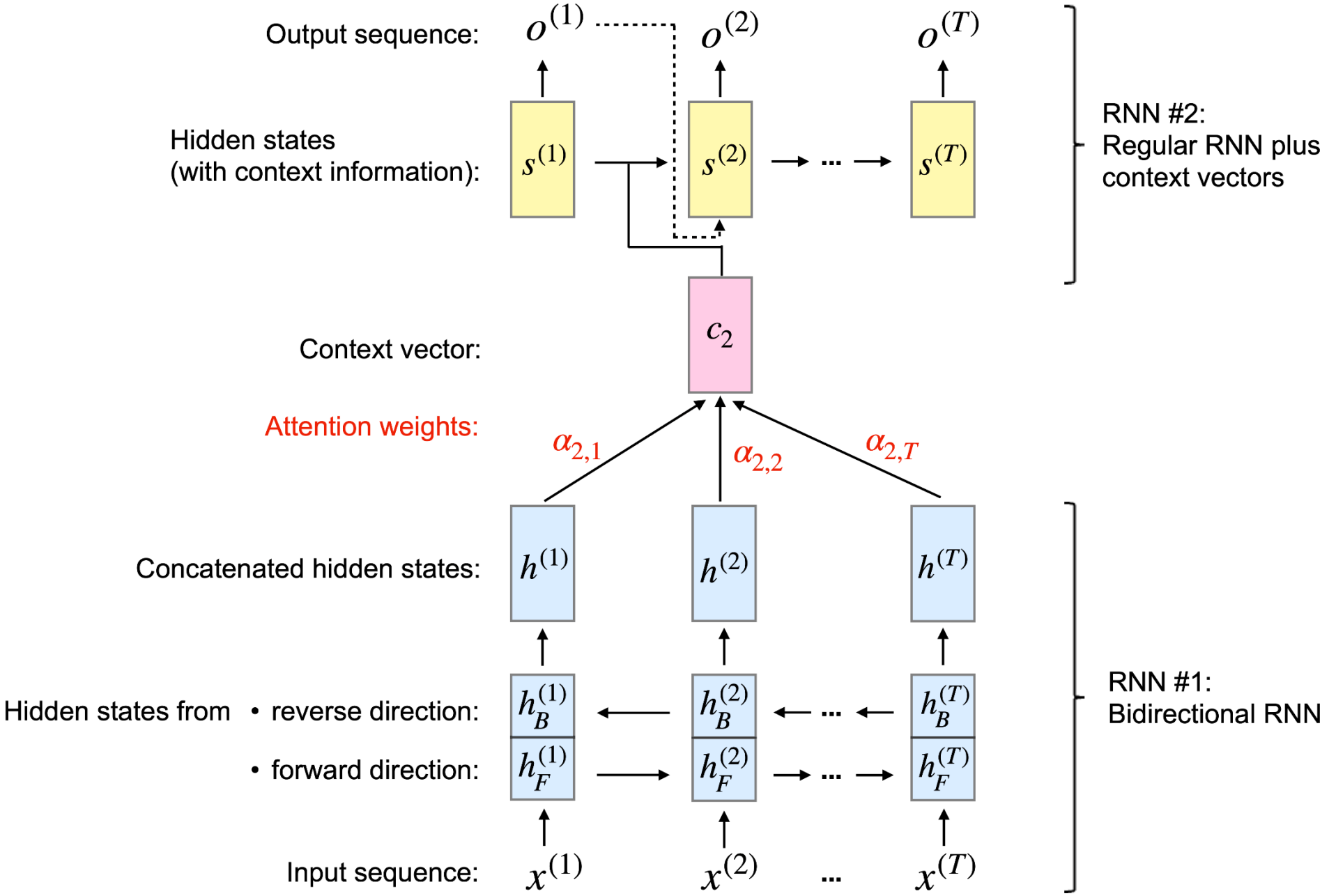
## Suggestion

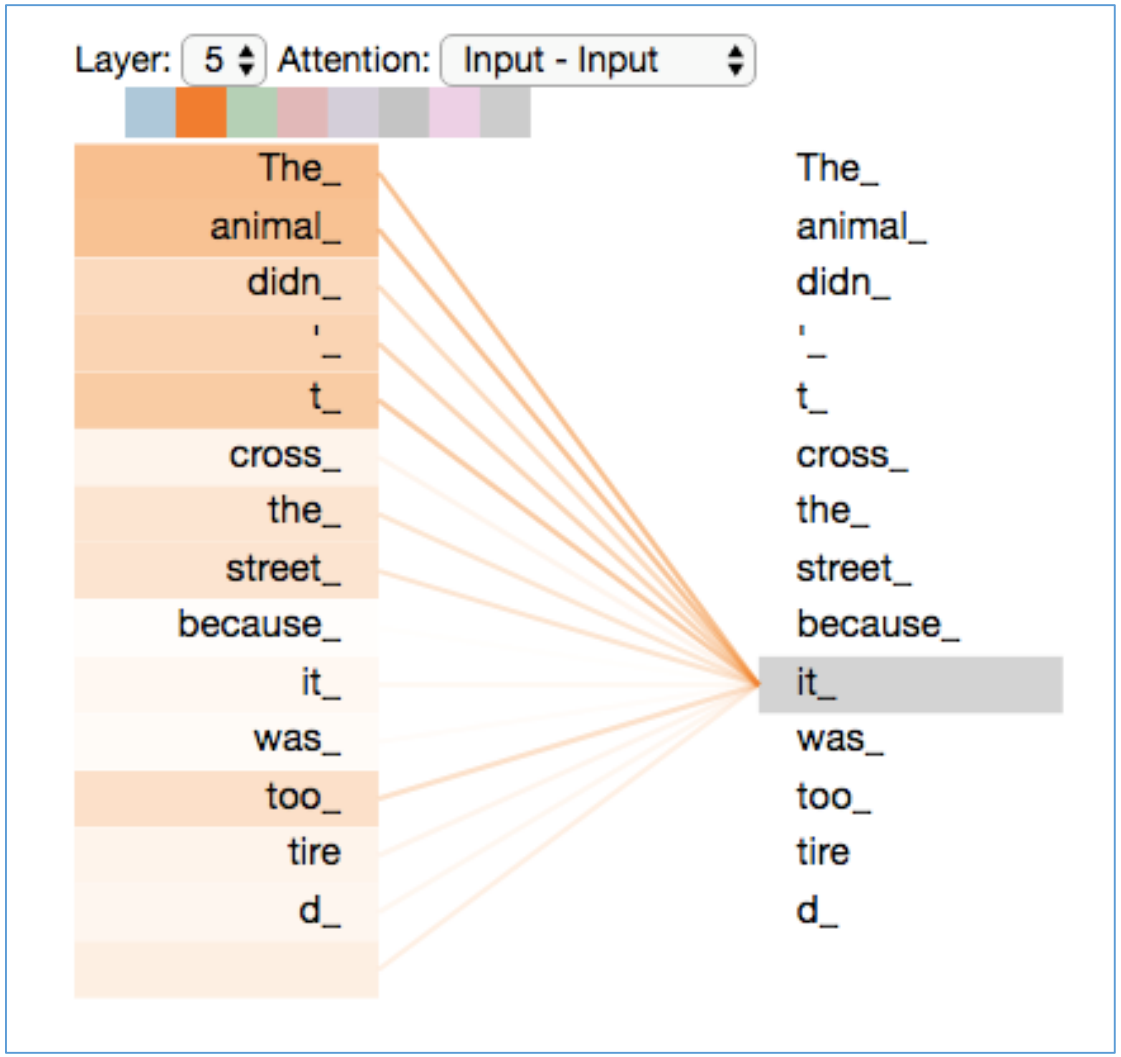
If you want to continue learning about machine learning, playing with pytorch or keras is the next step

# Large Language Models

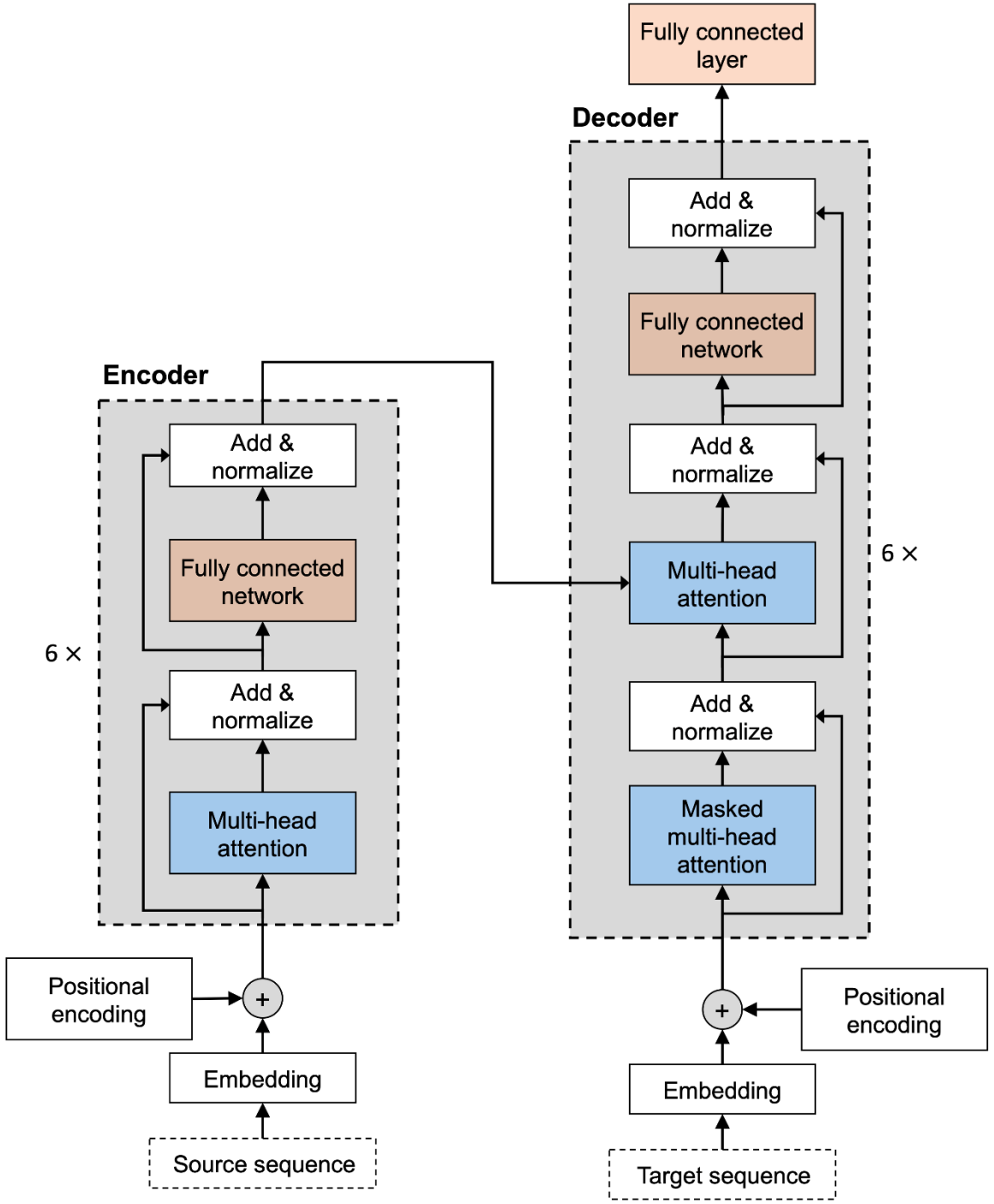
Such as Chat-GPT

https://github.com/rasbt/machine-learning-book/blob/main/ch16/ch16-part1-self-attention.ipynb






http://jalammar.github.io/illustrated-transformer/



# LLM

- https://en.wikipedia.org/wiki/Large_language_model
- http://jalammar.github.io/illustrated-transformer/
- https://sebastianraschka.com/blog/2023/llm-reading-list.html