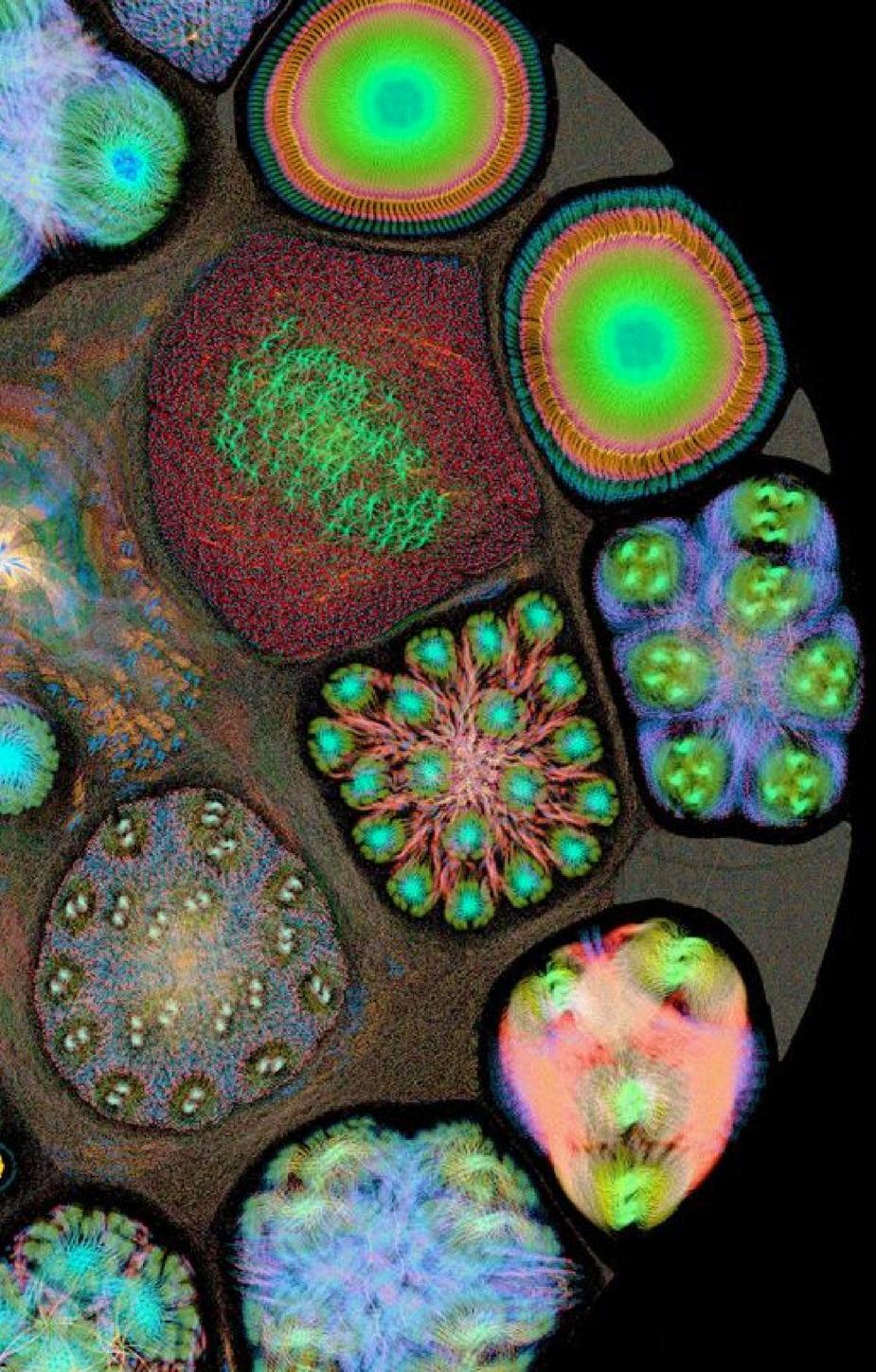


Machine learning in Design & Art

Digital DI Ideation

Day plan

1. Intro
2. Math
3. Machine Learning
4. Application of Neural Networks
5. ML in Art & Design
6. Workshop

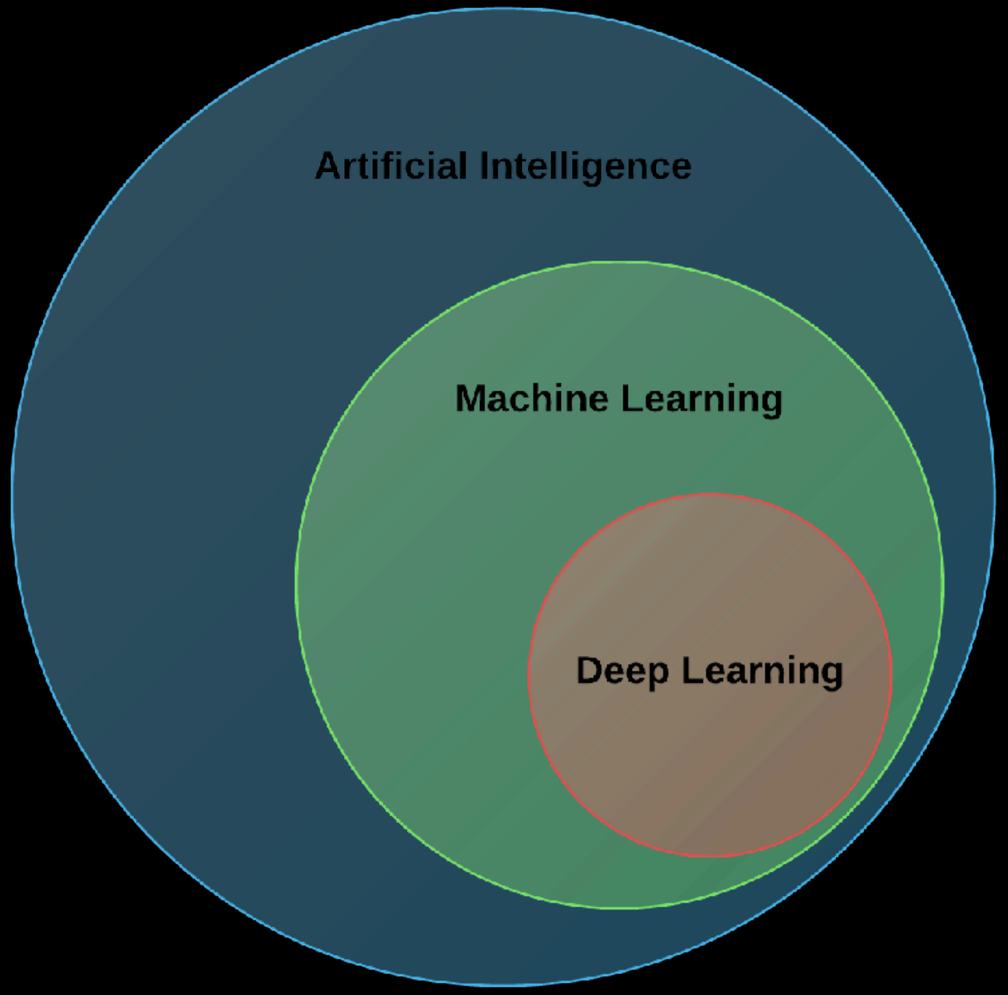
0. Hello

1. Intro

1.1 AI/ML/DL

AI:

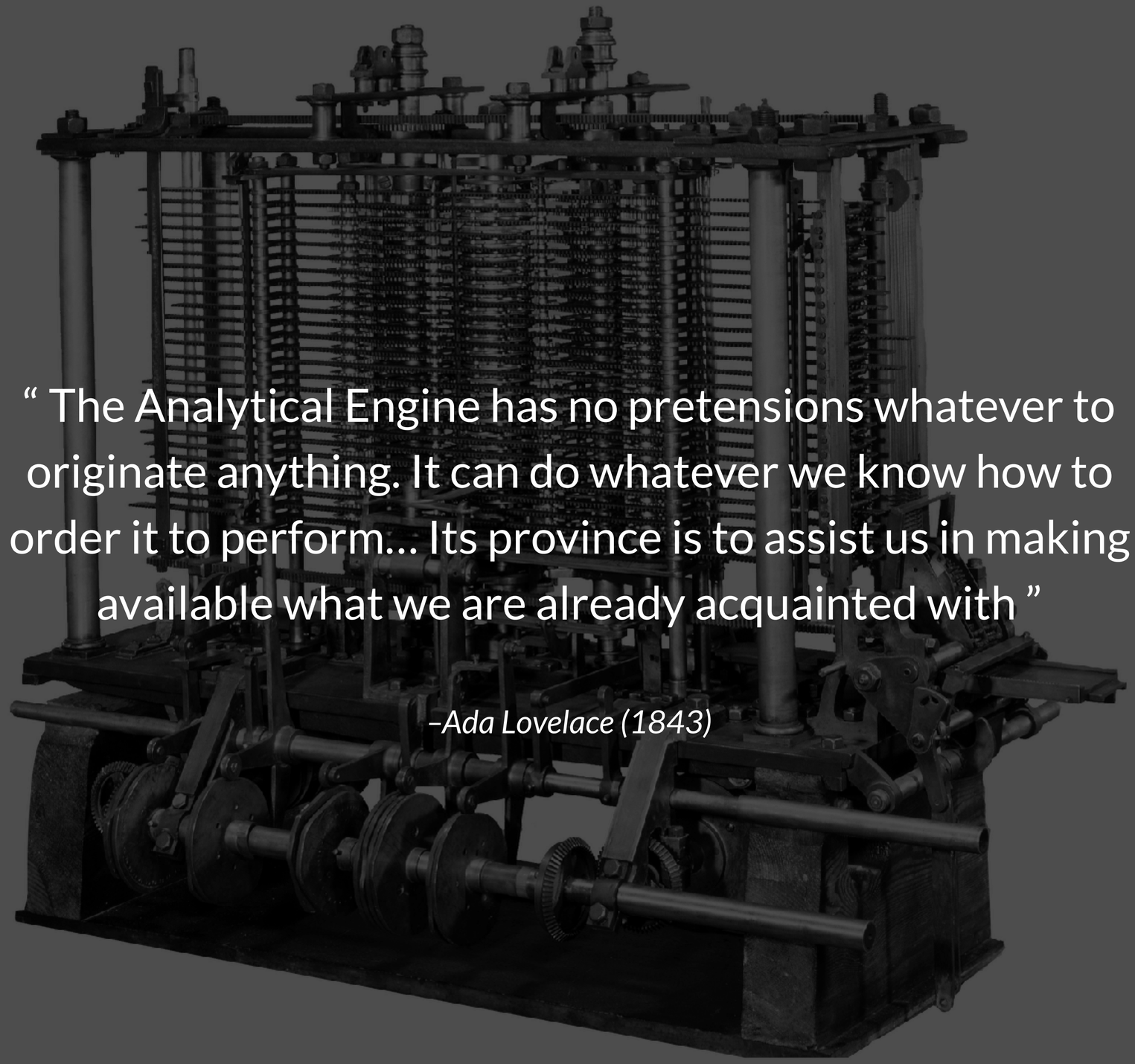
Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans.


Artificial Intelligence
Machine Learning
Deep Learning

ML:

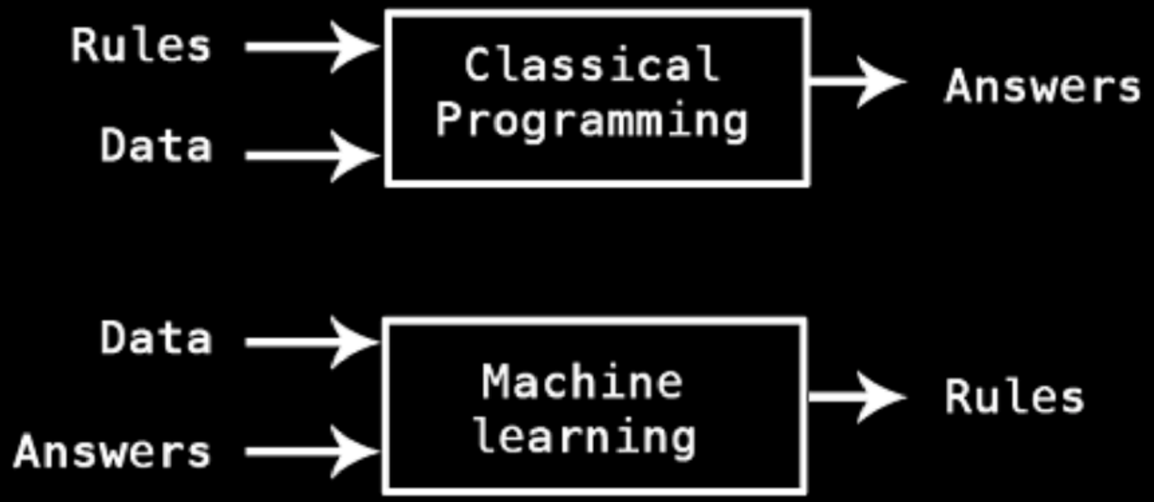
Machine Learning at its most basic is the practice of using algorithms to parse data, learn from it, and then make a determination or **prediction** about something in the world.

So rather than hand-coding software routines with a specific set of instructions to accomplish a particular task, the machine is “trained” using large amounts of data and algorithms that give it the ability to learn how to perform the task.



“ The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform… Its province is to assist us in making available what we are already acquainted with ”

–Ada Lovelace (1843)



(c) Francois Chollet. “Deep Learning with Python MEAP V06.”

1.2 Brief history of ML

ADD PAGE HERE

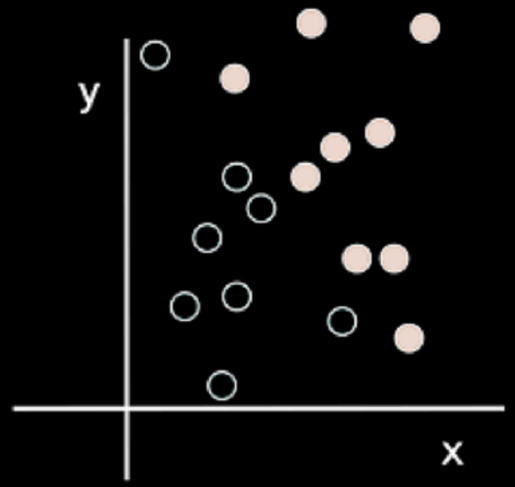
1.3 What is Deep Learning

DL:

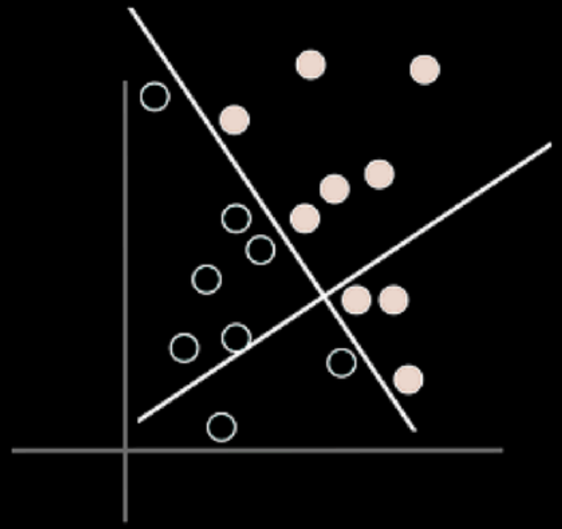
Deep learning is a specific subfield of machine learning, a new take on learning representations from data which puts an emphasis on learning successive **"layers"** of increasingly meaningful representations.

Learning representations from data

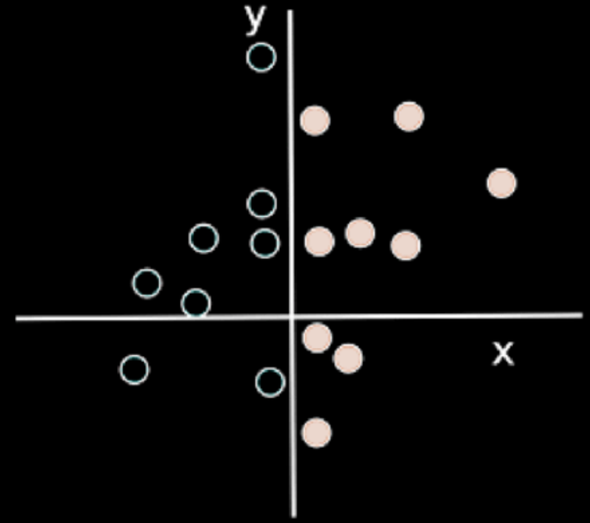
1: Raw data



2: Coordinate change

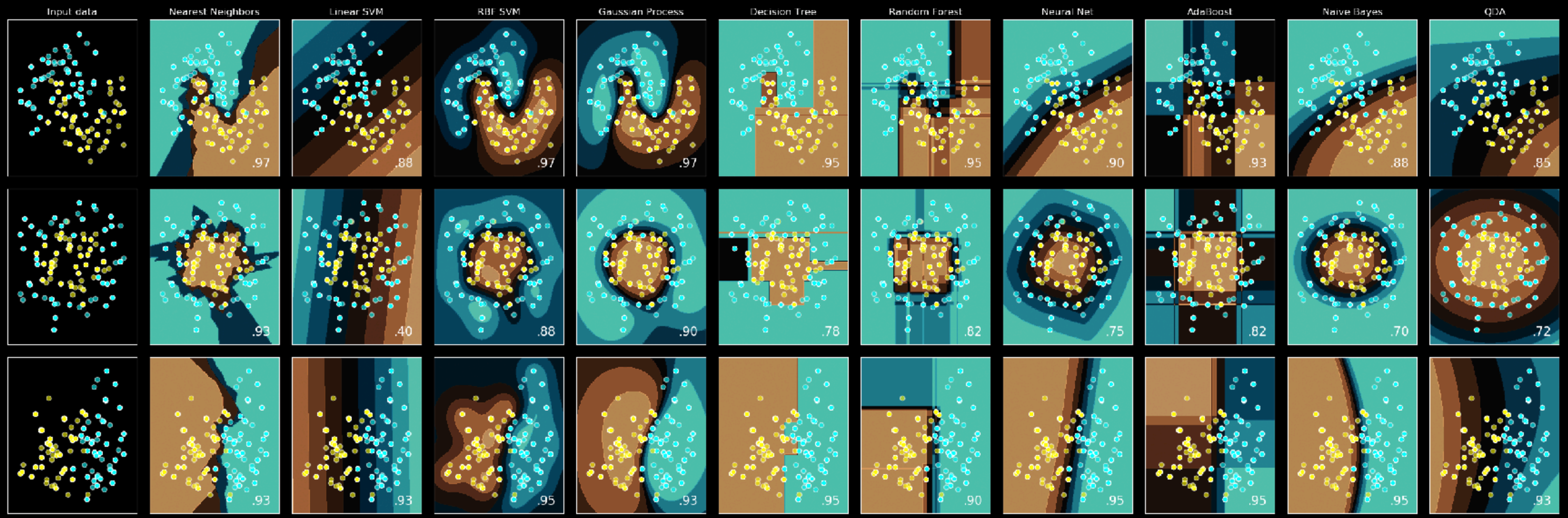


3: Better representation



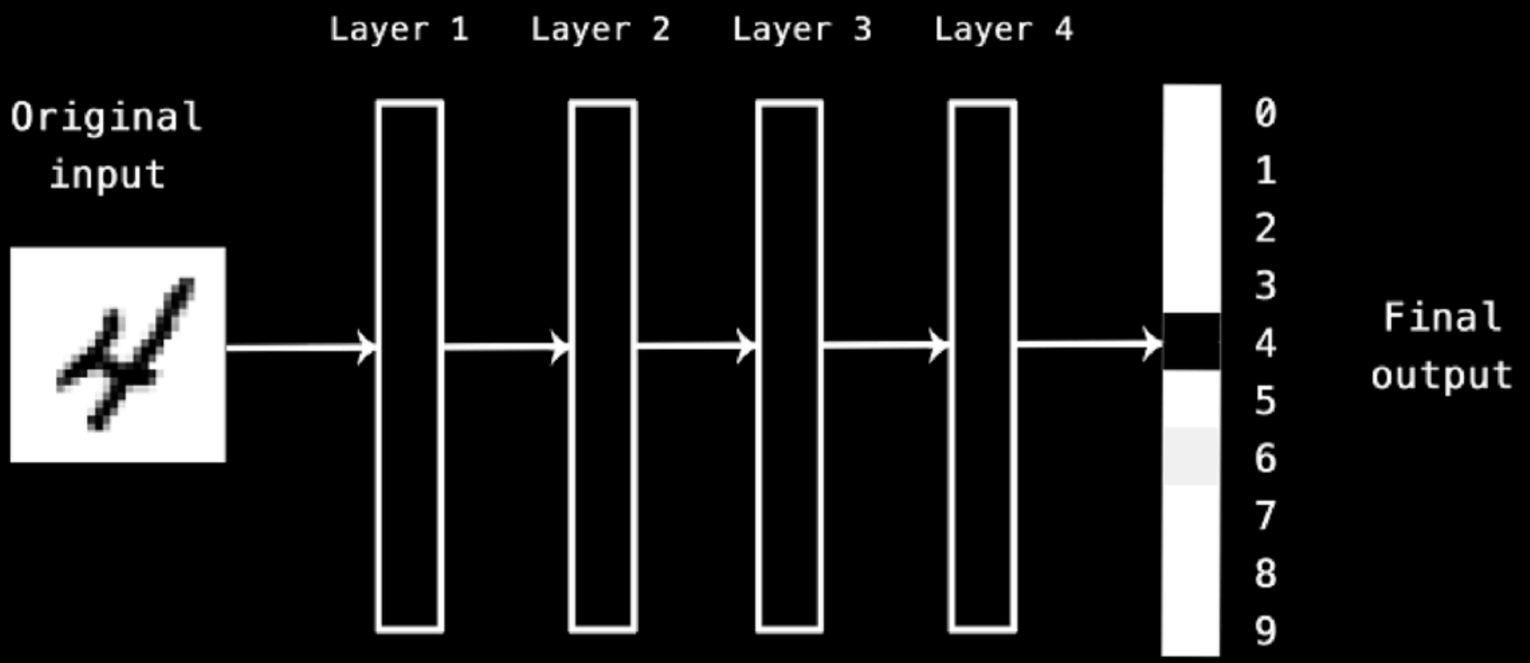
(c) Francois Chollet. “Deep Learning with Python MEAP V06.”

Example of other classifiers

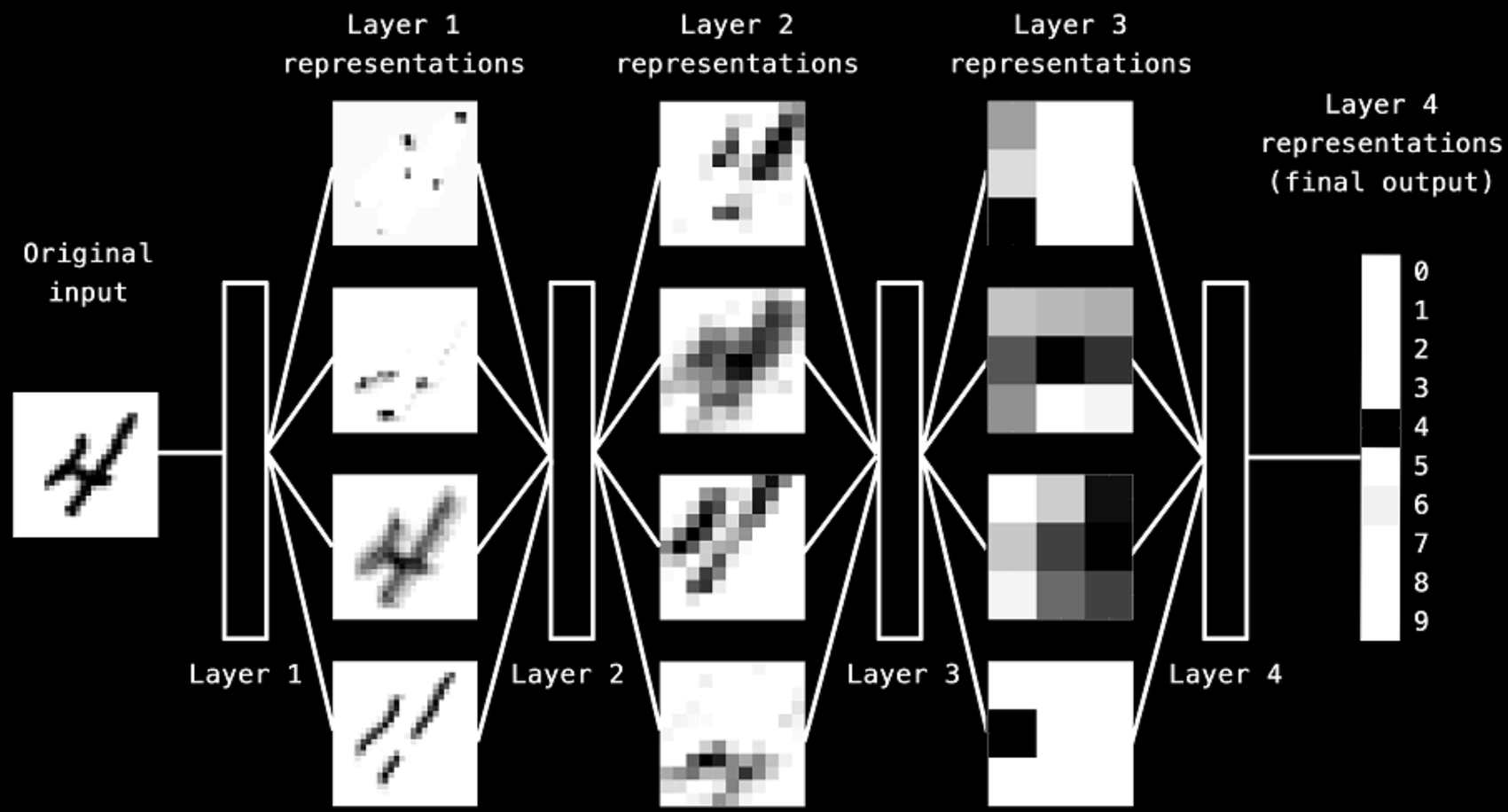


(c) Scikit-learn classifiers comparisons on synthetic datasets

The ‘Deep’ in Deep learning



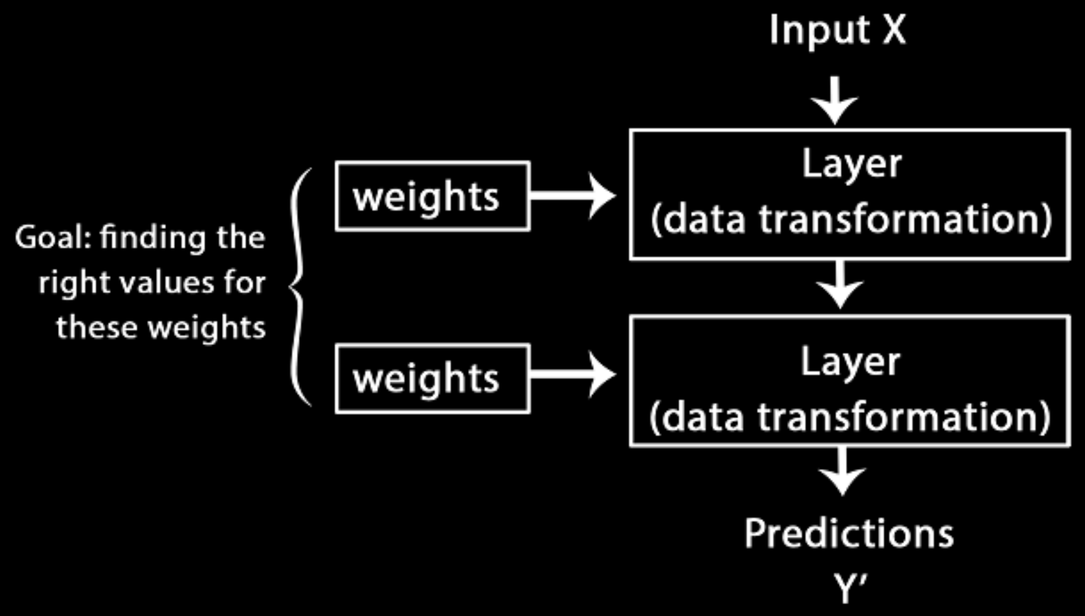
(c) Francois Chollet. “Deep Learning with Python MEAP V06.”



(c) Francois Chollet. "Deep Learning with Python MEAP V06."

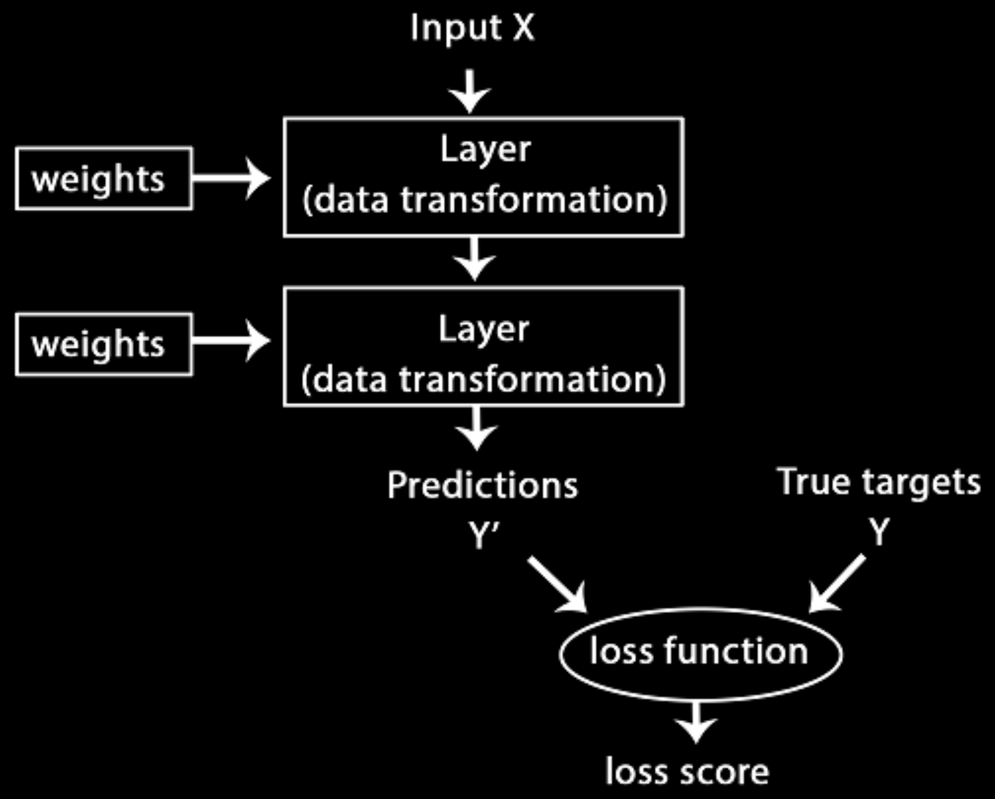
Understanding how deep learning works in three figures

A neural network is parametrized by its weights



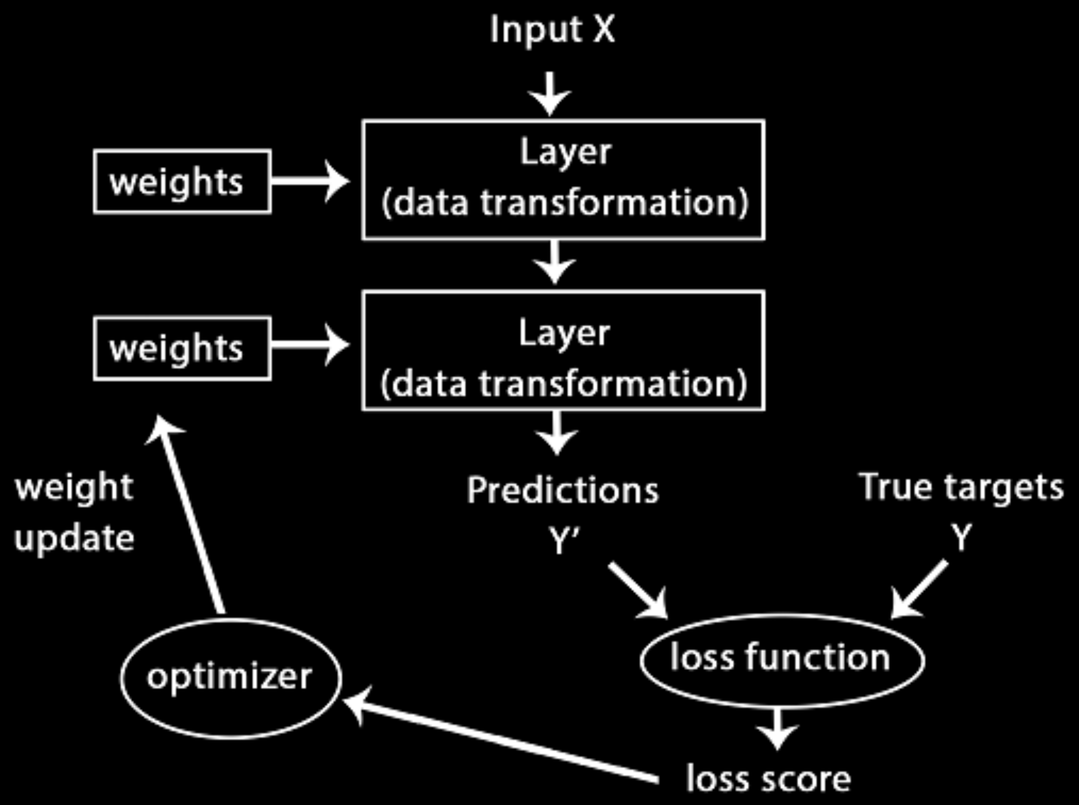
(c) Francois Chollet. "Deep Learning with Python MEAP V06."

A loss function measures the quality of the network's output



(c) Francois Chollet. "Deep Learning with Python MEAP V06."

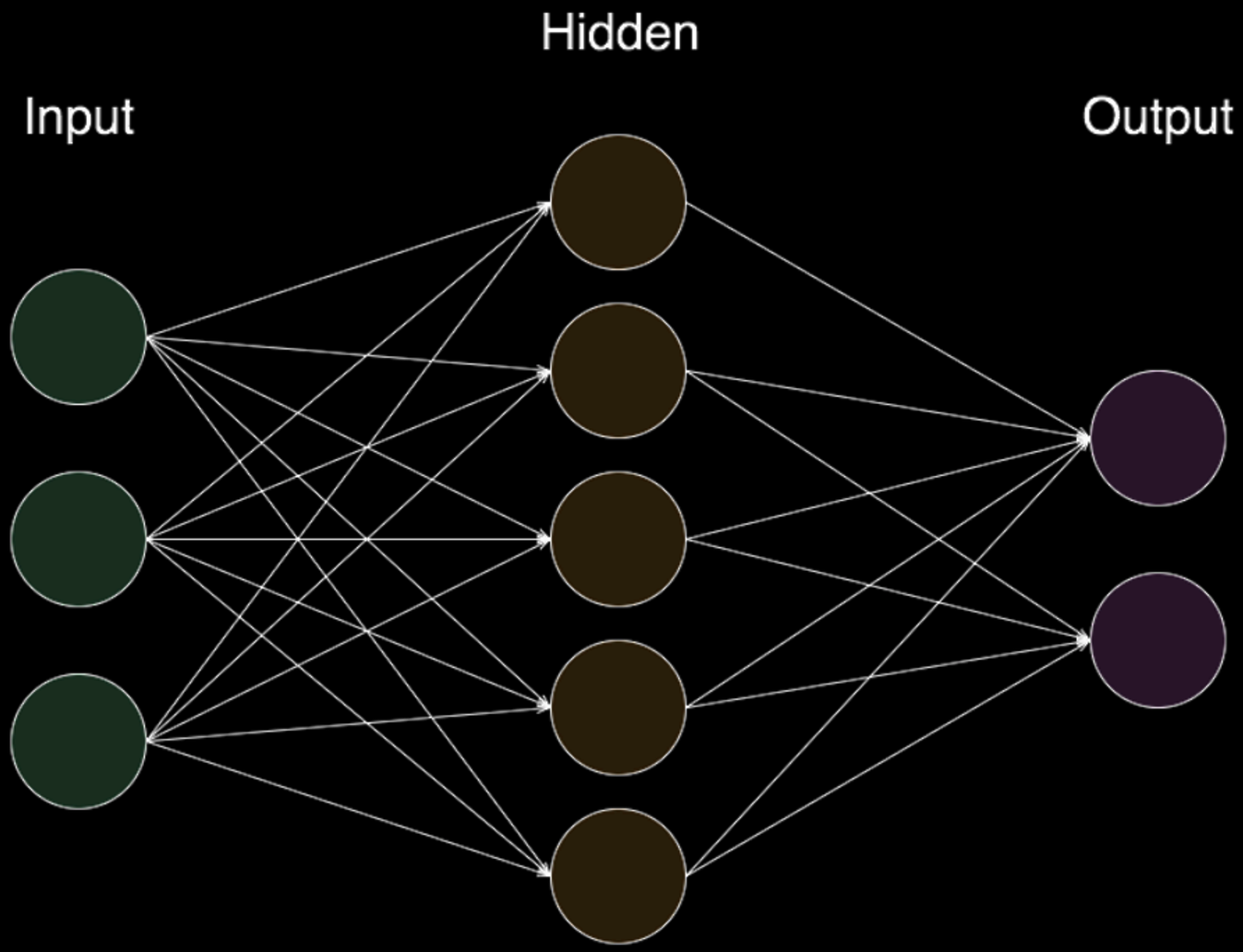
The loss score is used as a feedback signal to adjust the weights

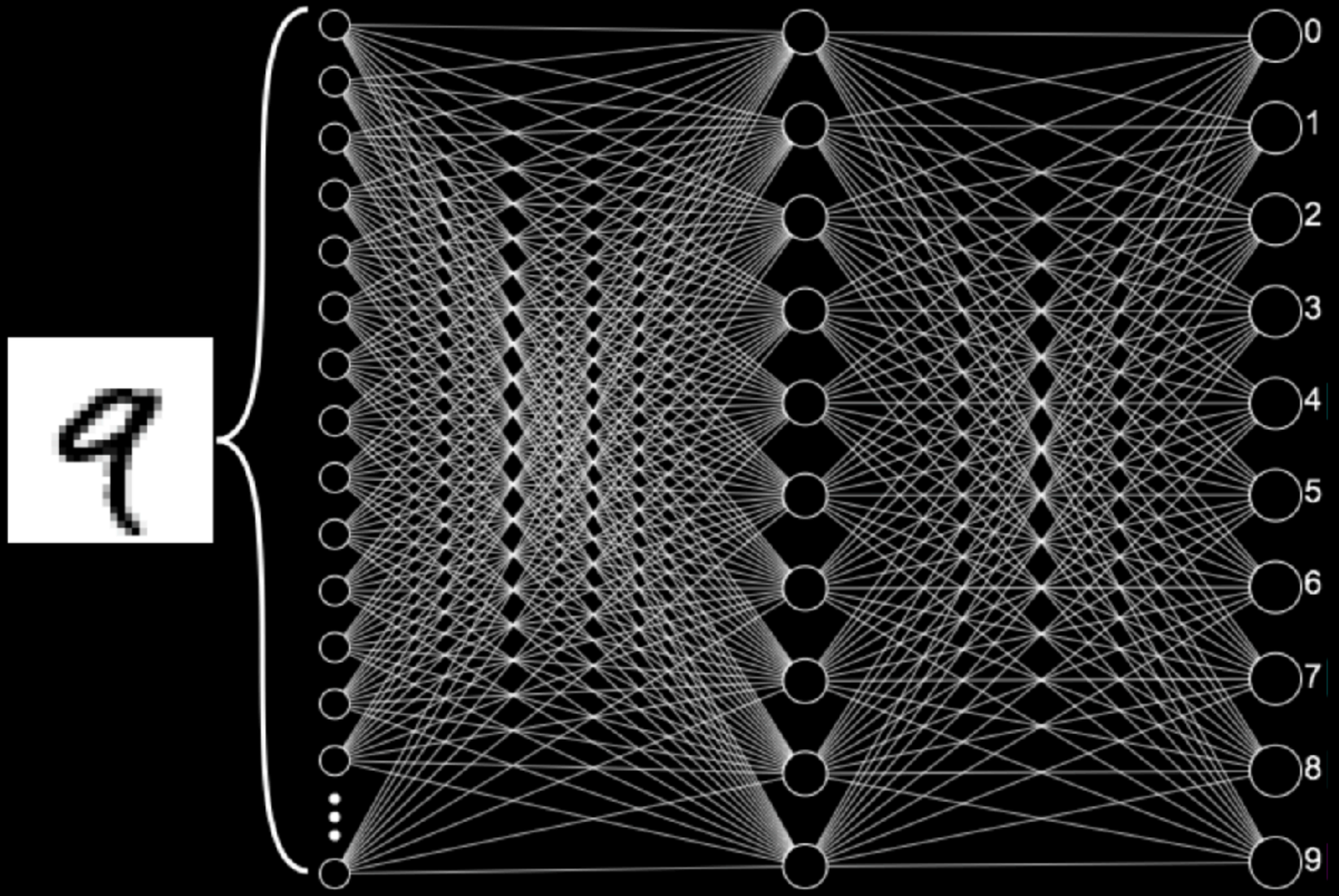


(c) Francois Chollet. "Deep Learning with Python MEAP V06."

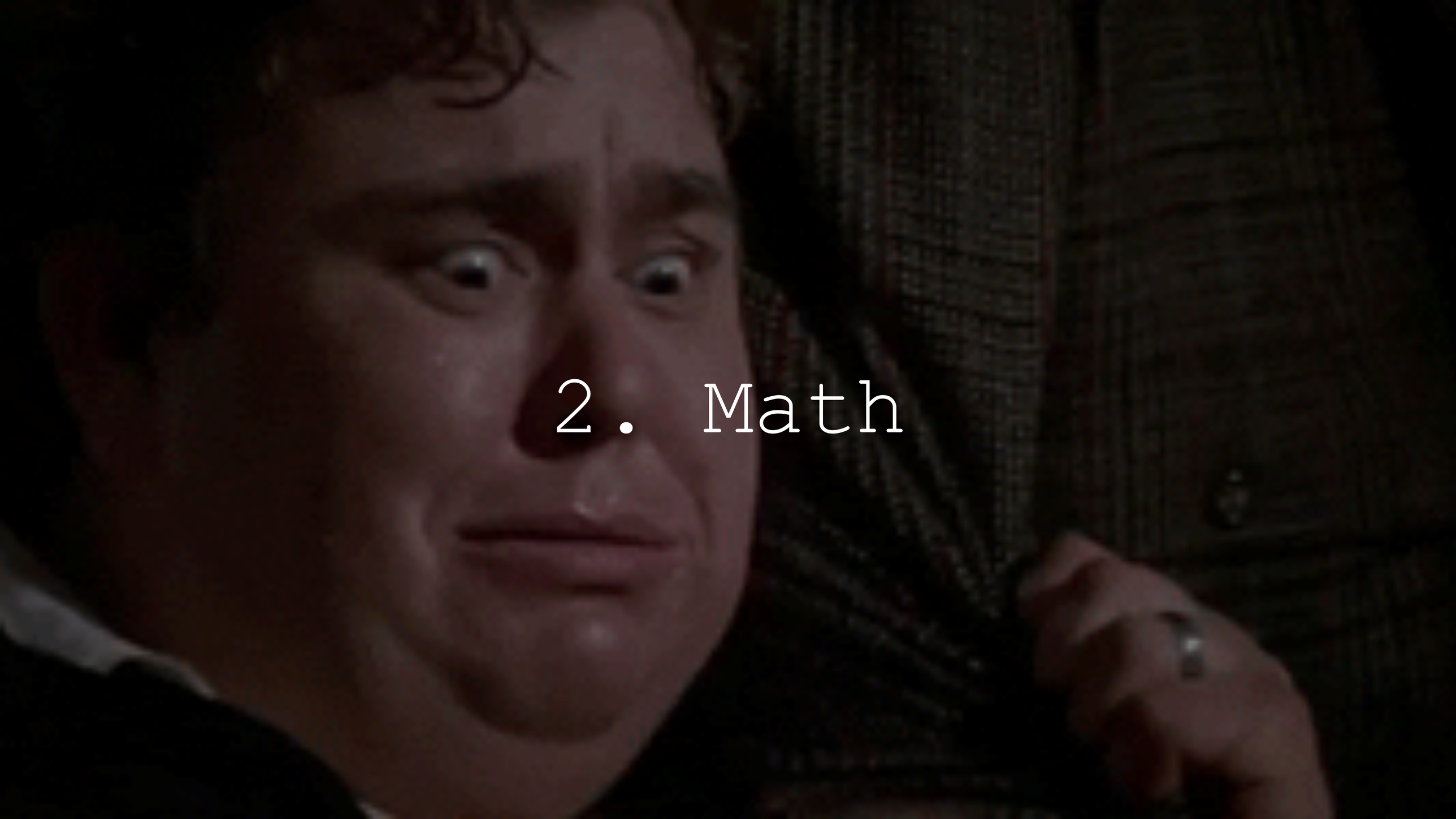
1.4 Why now?

1.5 Bird-view of a NN


Hidden
Input
Output


0
1
2
3
4
5
6
7
8
9

Setup env
(tf.js ML5.js)



2. Math

2.1 MNIST EXAMPLE

2.2 DATA REPRESENTATIONS FOR NEURAL NETWORKS


LA Makerspace: Hands-on AI for Kids!
MORE VIDEOS
LA MAKER SPACE
0:05 / 3:30
HD
YouTube

- Scalars (0D Tensors)
- Vectors (1D Tensors)
- Matrices (2D Tensors)
- 3D + Tensors

Key attributes

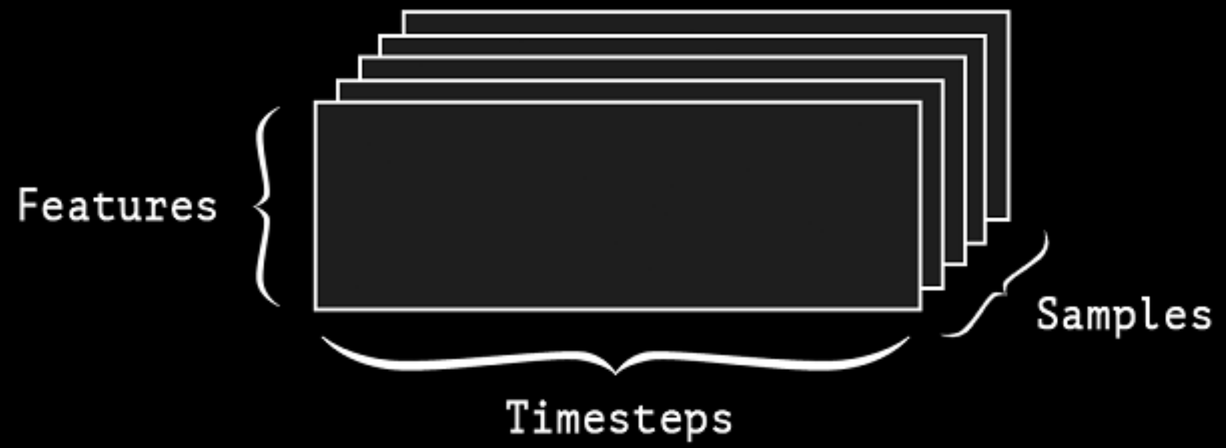
- The number of axes it has, its **rank**. For instance, a 3D tensor has 3 axes, and a matrix has 2 axes.
- Its **shape**. This is a tuple of integers that describes how many dimensions the tensor has along each axis.
- Its **data type** (usually called dtype throughout Python libraries). This is the type of the data contained inside the tensor; for instance a tensor's type could be float32, uint8, float64…

Tensors

Real-world examples of data tensors

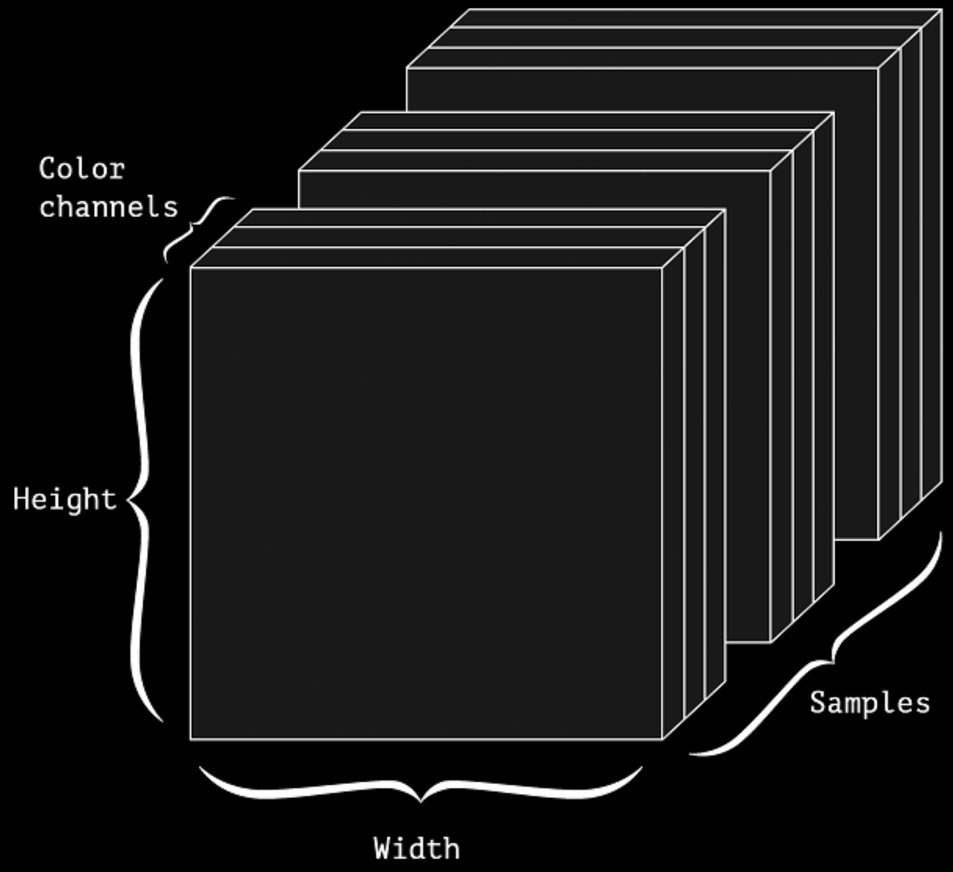
- Vector data: 2D tensors of shape (samples, features).
- Timeseries data or sequence data: 3D tensors of shape (samples, timesteps, features).
- Images: 4D tensors of shape (samples, width, height, channels) or (samples, channels, width, height).
- Video: 5D tensors of shape (samples, frames, width, height, channels) or (samples, frames, channels, width, height).

Timeseries data or sequence data



(c) Francois Chollet. “Deep Learning with Python MEAP V06.”

Image data

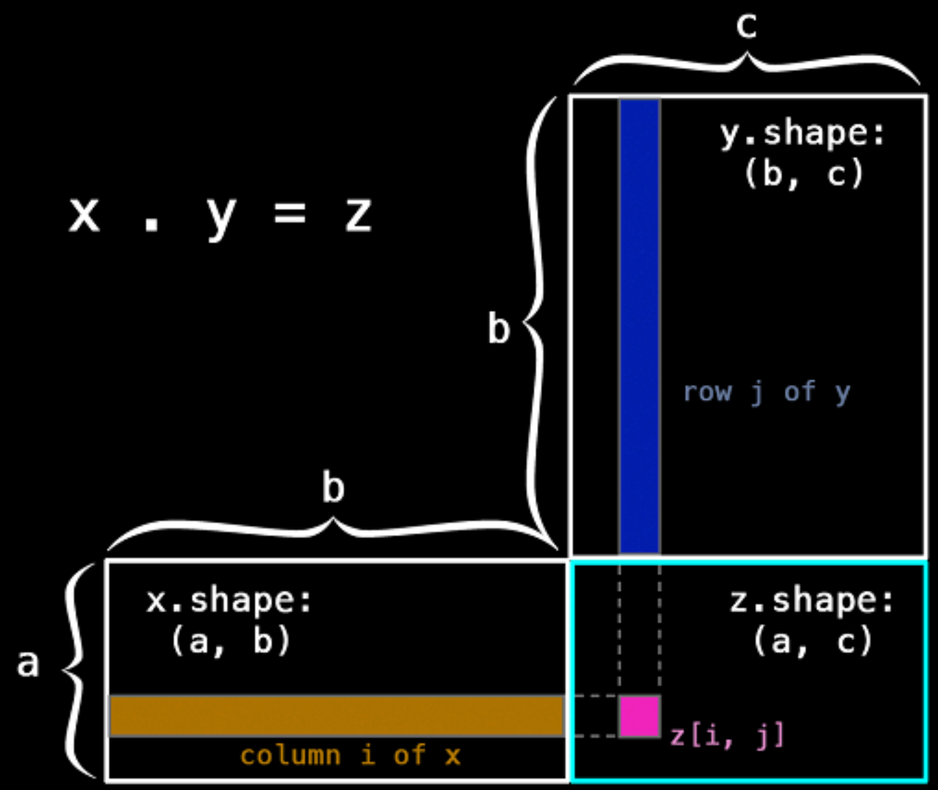


(c) Francois Chollet. “Deep Learning with Python MEAP V06.”

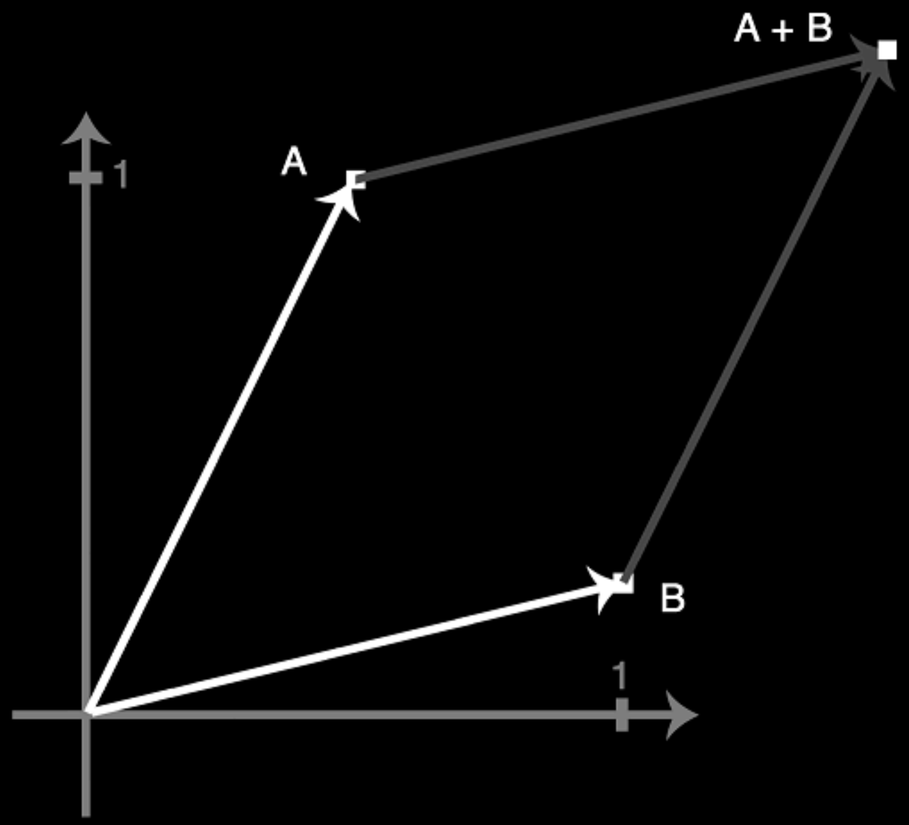
2.3 THE GEARS OF NEURAL NETWORKS: TENSOR OPERATIONS

- Element-wise operations
- Broadcasting
- Tensor dot
- Tensor reshaping

Dot product



Geometric interpretation of tensor operations



(c) Francois Chollet. “Deep Learning with Python MEAP V06.”

2.4 THE ENGINE OF NEURAL NETWORKS: GRADIENT-BASED OPTIMIZATION

Training loop

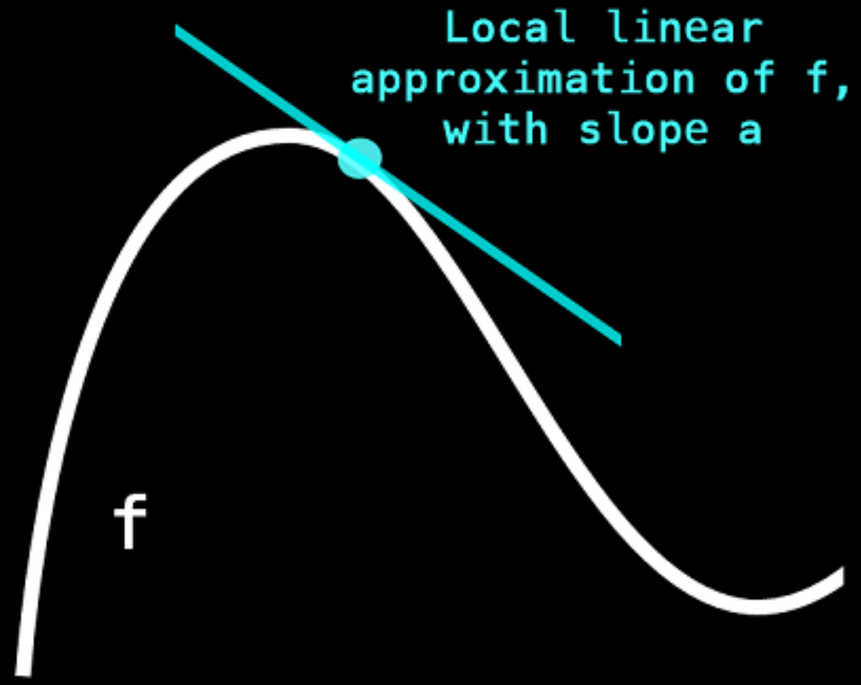
1. Draw a batch of training samples x and corresponding targets y

2. Run the network on x (this is called "forward pass”), obtain predictions y_pred

3. Compute the "loss" of the network on the batch, a measure of the mismatch between y_pred and y

4. Update all weights of the network in a way that slightly reduces the loss on this batch.

Derivative in 1D



(c) Francois Chollet. “Deep Learning with Python MEAP V06.”

Training loop

1. Draw a batch of training samples x and corresponding targets y

2. Run the network on x (this is called "forward pass”) obtain predictions y_pred

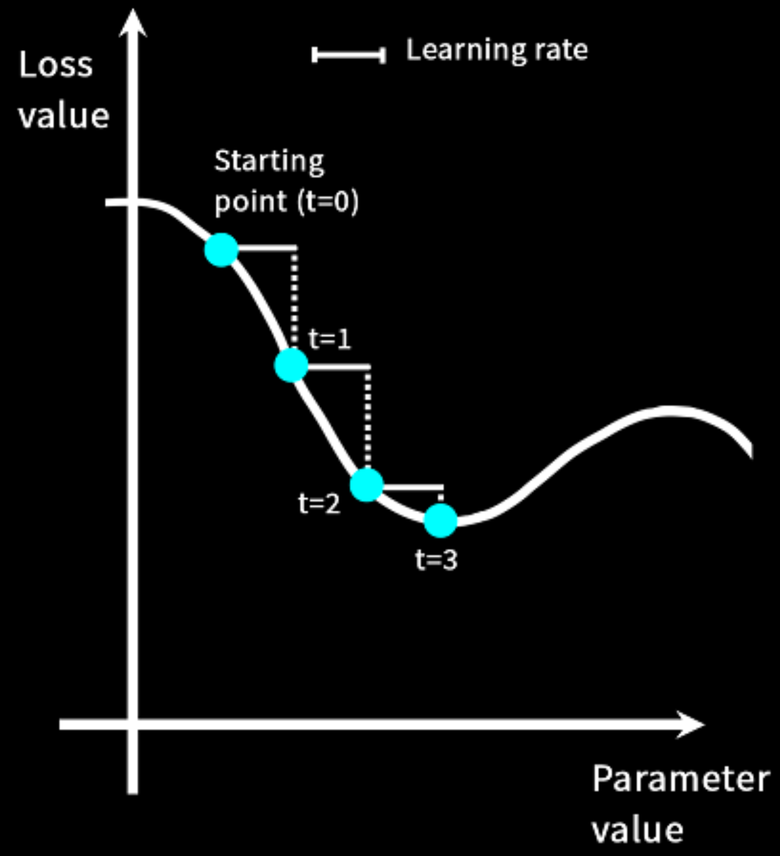
3. Compute the "loss" of the network on the batch, a measure of the mismatch between y_pred and y

4. Update all weights of the network in a way that slightly reduces the loss on this batch:

    1. Compute the gradient of the loss with regard to the parameters of the network (this is called "backward pass")

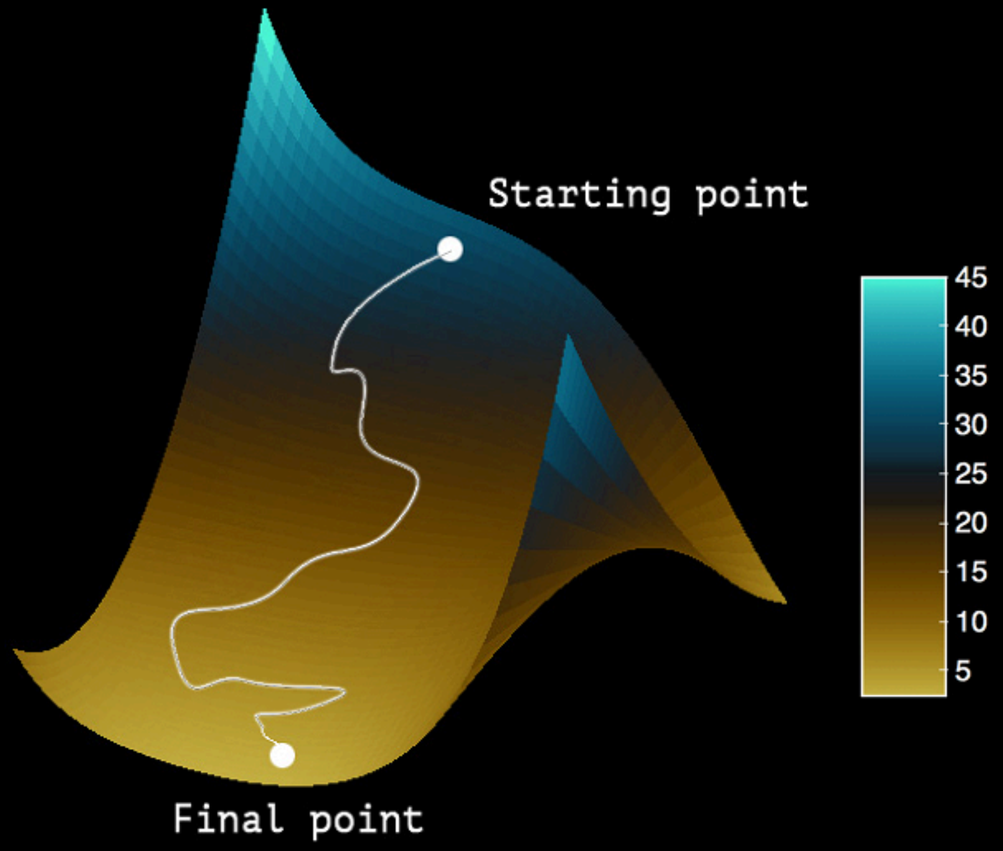
    2. Move the parameters a little in the direction opposite to the gradient, thus lowering the loss on the batch by a bit.

SGD down a 1D loss curve (1 learnable parameter)



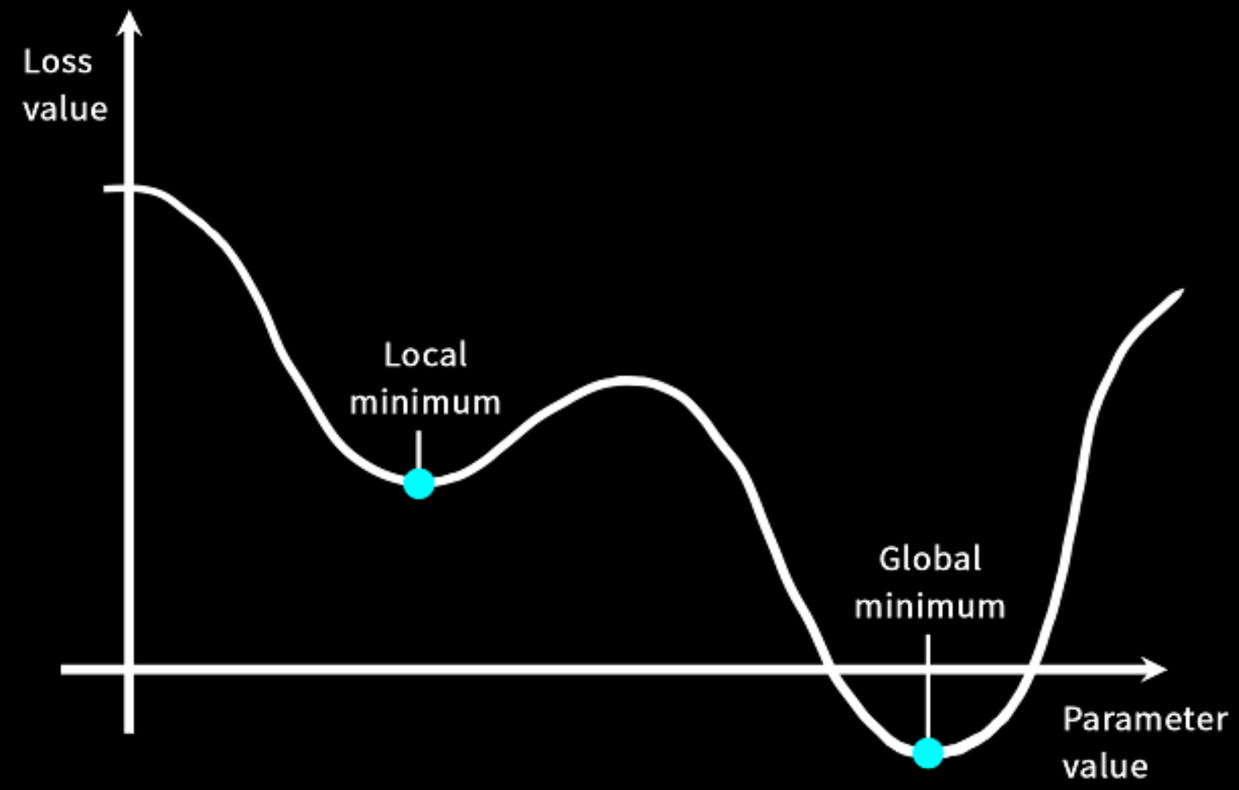
(c) Francois Chollet. "Deep Learning with Python MEAP V06."

SGD down a 2D loss curve (2 learnable parameter)



(c) Francois Chollet. "Deep Learning with Python MEAP V06."

A local minimum and a global minimum

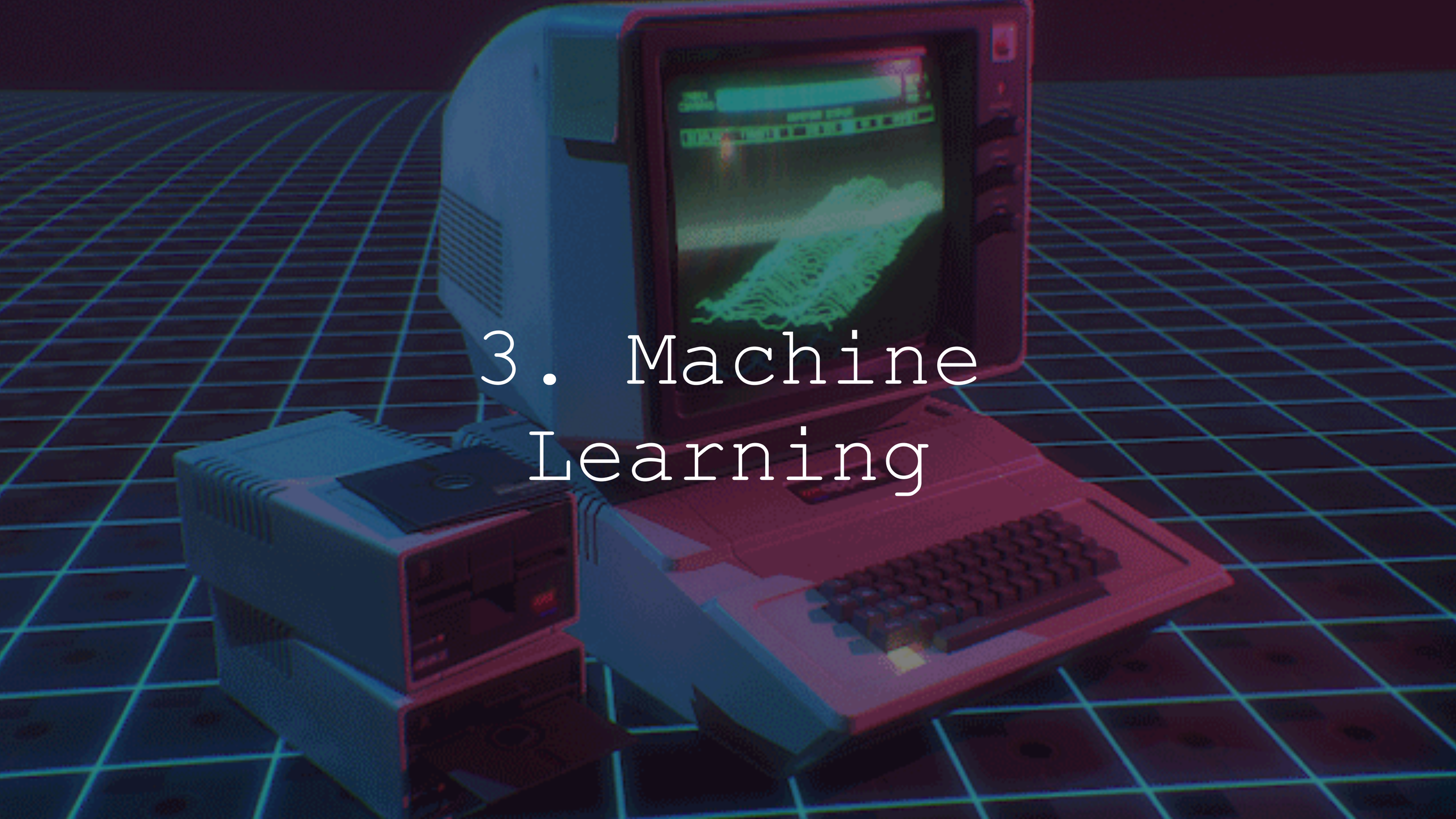


(c) Francois Chollet. "Deep Learning with Python MEAP V06."

Chaining derivatives: the backpropagation algorithm

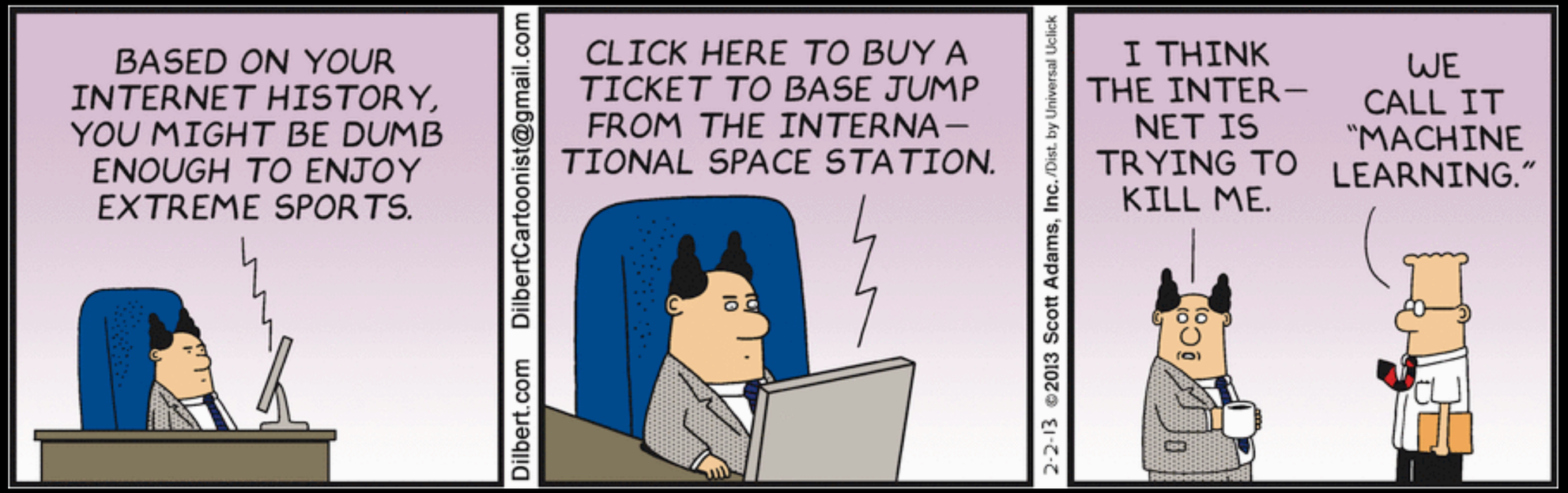
"Learning" simply means finding a combination of model parameters that minimizes a loss function for a given set of training data samples and their corresponding targets

2.5 LOOKING BACK ON OUR MNIST EXAMPLE



3. Machine Learning

3.1 What is ML?


BASED ON YOUR INTERNET HISTORY, YOU MIGHT BE DUMB ENOUGH TO ENJOY EXTREME SPORTS.
Dilbert.com DilbertCartoonist@gmail.com
CLICK HERE TO BUY A TICKET TO BASE JUMP FROM THE INTERNA— TIONAL SPACE STATION.
2-2-13 ©2013 Scott Adams, Inc./Dist. by Universal Uclick
I THINK THE INTER— NET IS TRYING TO KILL ME.
WE CALL IT "MACHINE LEARNING."

Machine learning is fun

- https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471
- Intro to machine learning with pseudo code for house price predictions

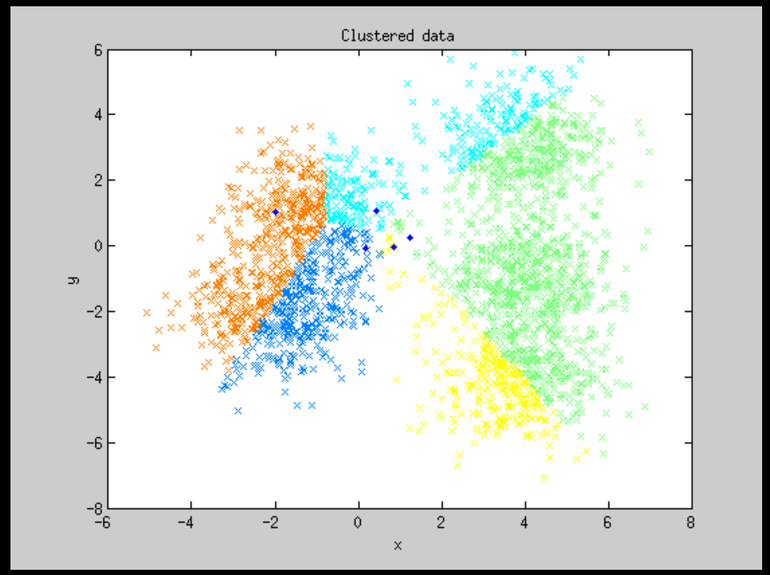
3.2 Four different kinds of ML

Supervised Learning

Learning to map input data to known targets (also called annotations), given a set of examples (often annotated by humans)

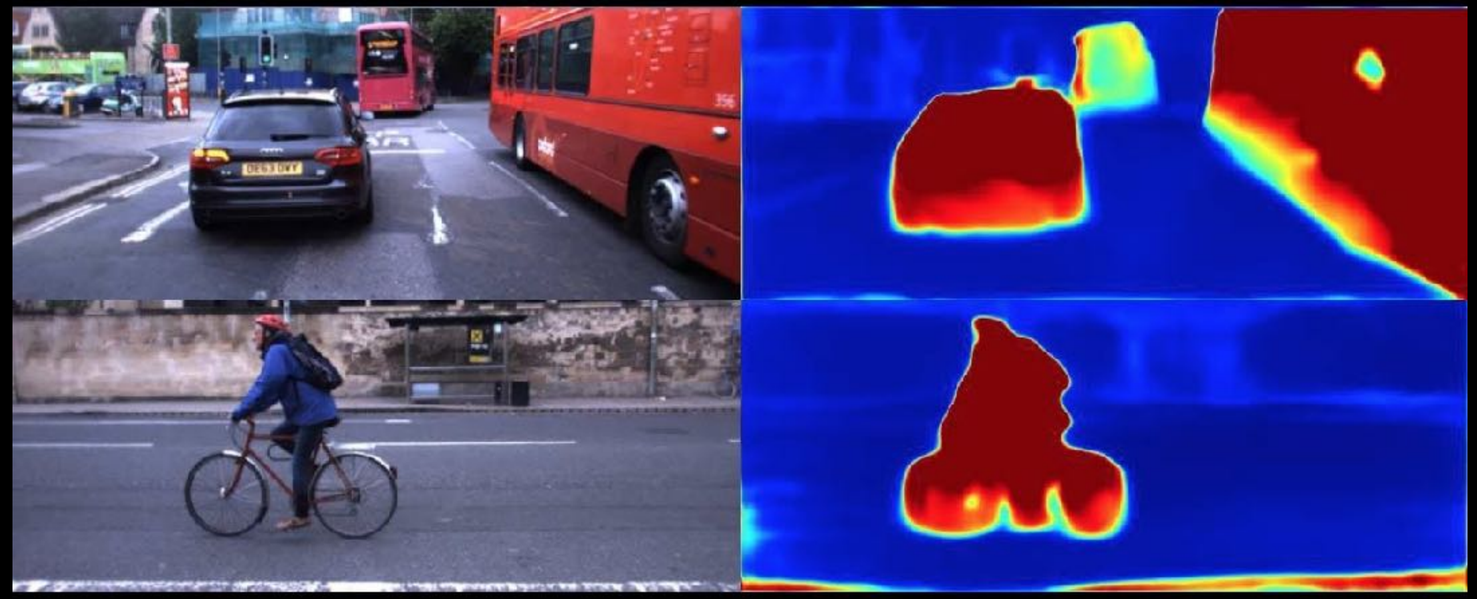
Unsupervised Learning

Finding interesting transformations of the input data without the help of any targets



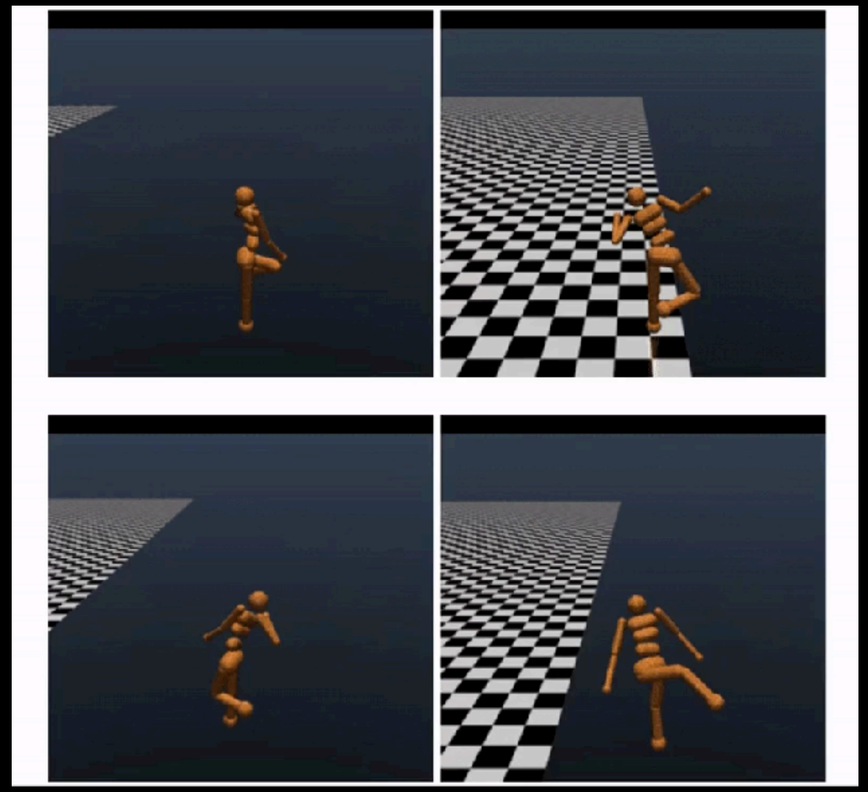
Self Supervised Learning

Supervised learning without human-annotated labels.
There are still labels involved (since the learning has to be supervised by something), but they are generated from the input data itself, typically using a heuristic algorithm



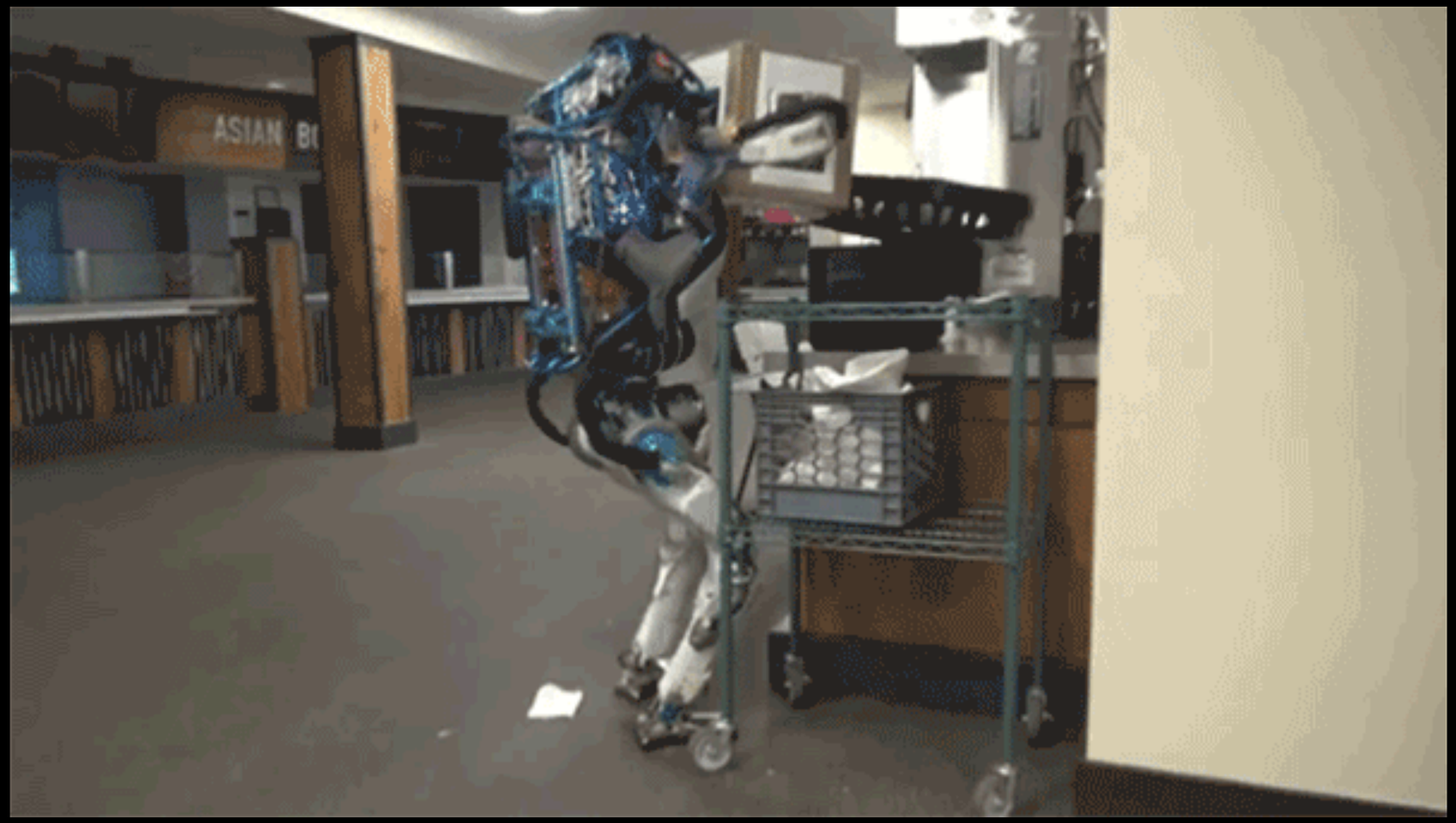
Reinforcement learning

In reinforcement learning, an "agent" receives information about its environment and learns to pick actions that will maximize some reward.



Reinforcement learning

Reinforcement learning



More here: https://www.theverge.com/2015/6/6/8741143/robots-falling-down-during-darpa-robotics-challenge

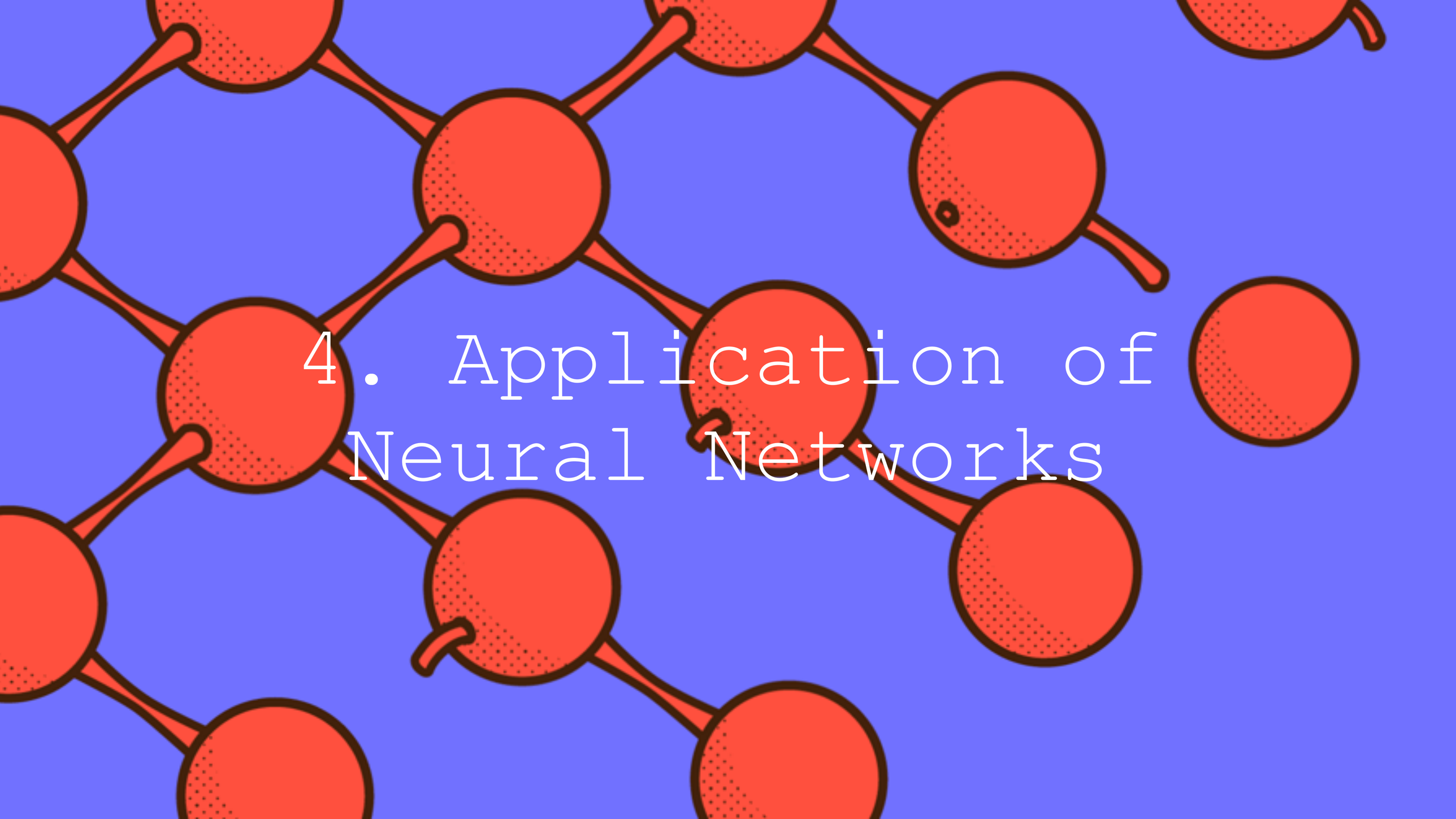
More?? https://twitter.com/Sosowski/status/952979592972783617

3.3 A deeper look into NN

References

- https://medium.com/@ageitgey/machine-learning-is-fun-part-2-a26a10b68df3
- https://ml4a.github.io/ml4a/neural_networks/
- https://ml4a.github.io/ml4a/looking_inside_neural_nets/
- http://playground.tensorflow.org/

Pause?



4. Application of Neural Networks

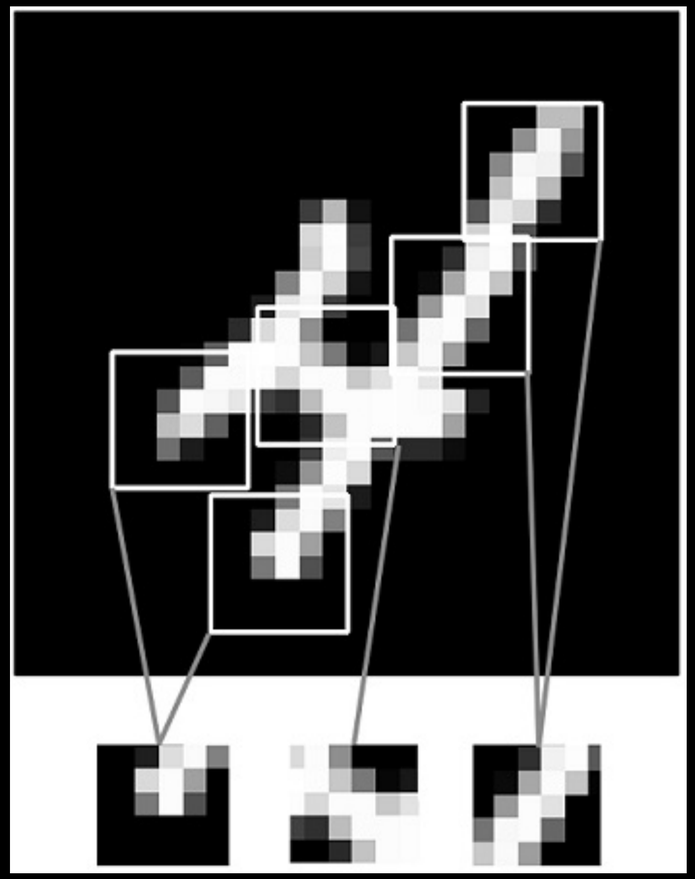
4.1 Computer Vision: Convnets

References

- https://medium.com/@ageitgey/machine-learning-is-fun-part-3-deep-learning-and-convolutional-neural-networks-f40359318721

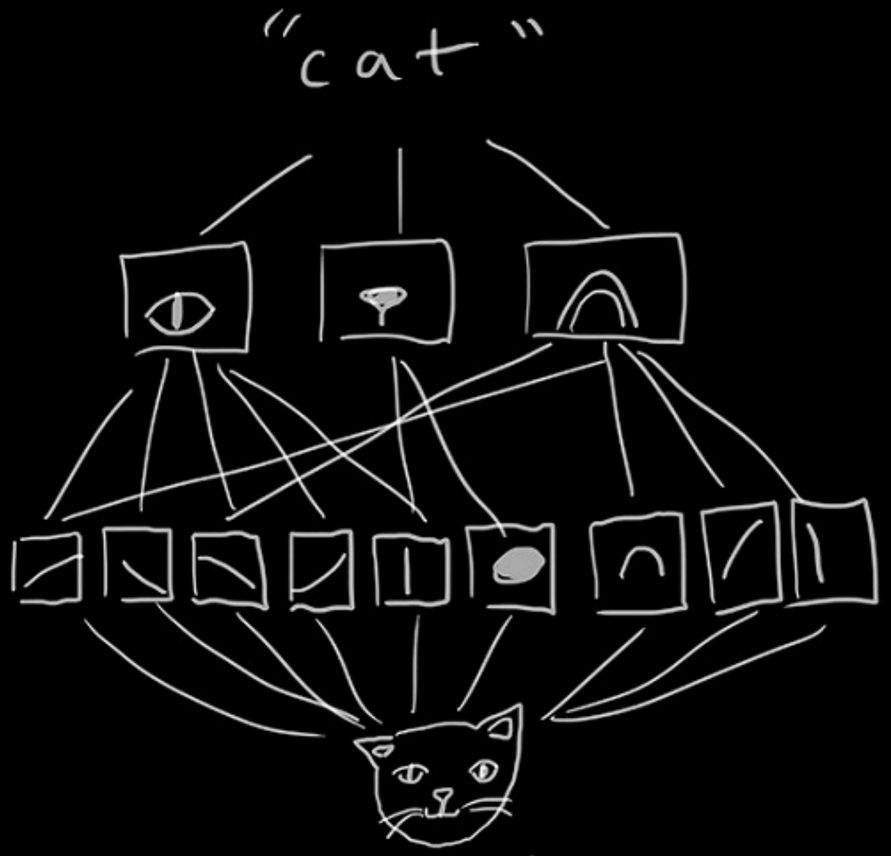
  The Solution is Convolution + How Convolution Works

Local Patterns



(c) Francois Chollet. “Deep Learning with Python MEAP V06.”

Abstract visual concepts



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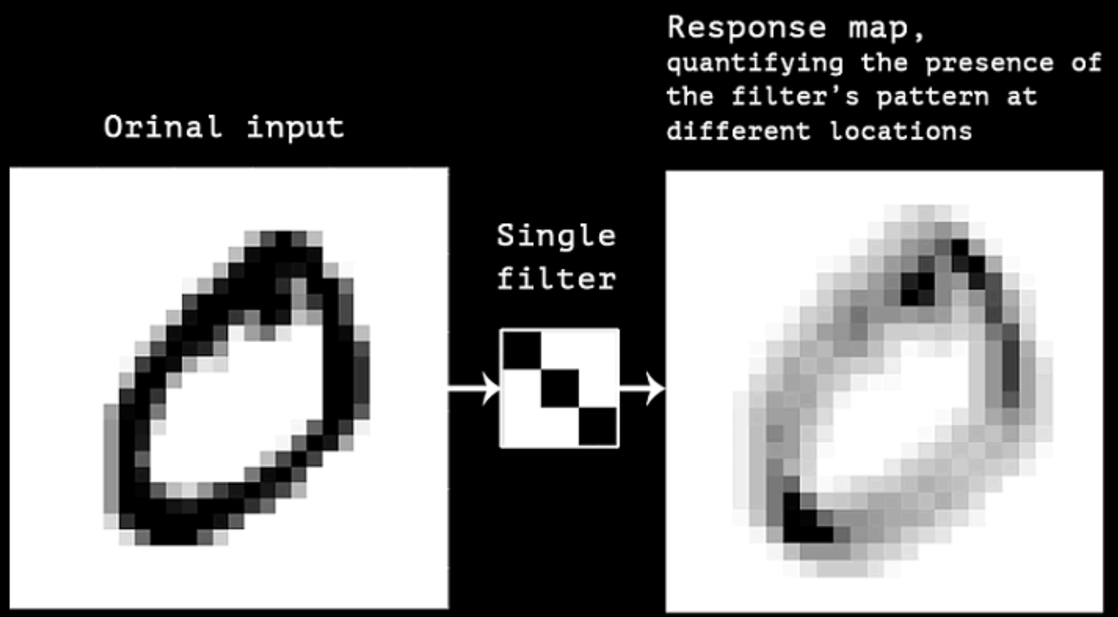
Feature map



(c) Francois Chollet. “Deep Learning with Python MEAP V06.”

References

- Reference: KPII-ObjectsViewer
- https://www.youtube.com/watch?v=AgkfIQ4IGaM

MNIST WITH CONVNETS

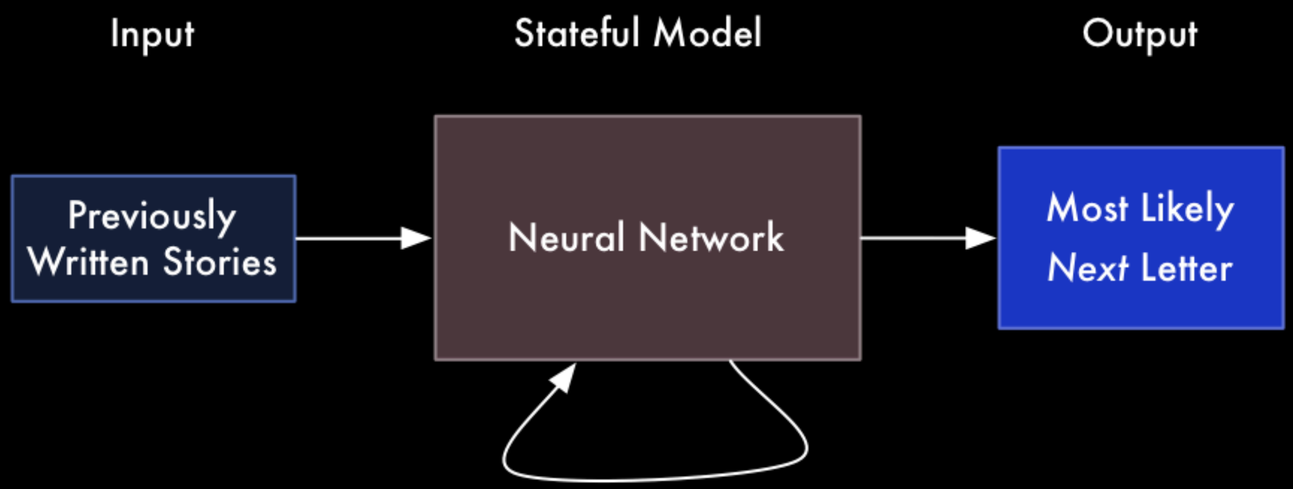
Going further

- https://colah.github.io/posts/2014-07-Conv-Nets-Modular/
- https://distill.pub/2017/feature-visualization/
- https://distill.pub/2018/building-blocks/
- http://yosinski.com/deepvis

4.2 Series of data: RNN

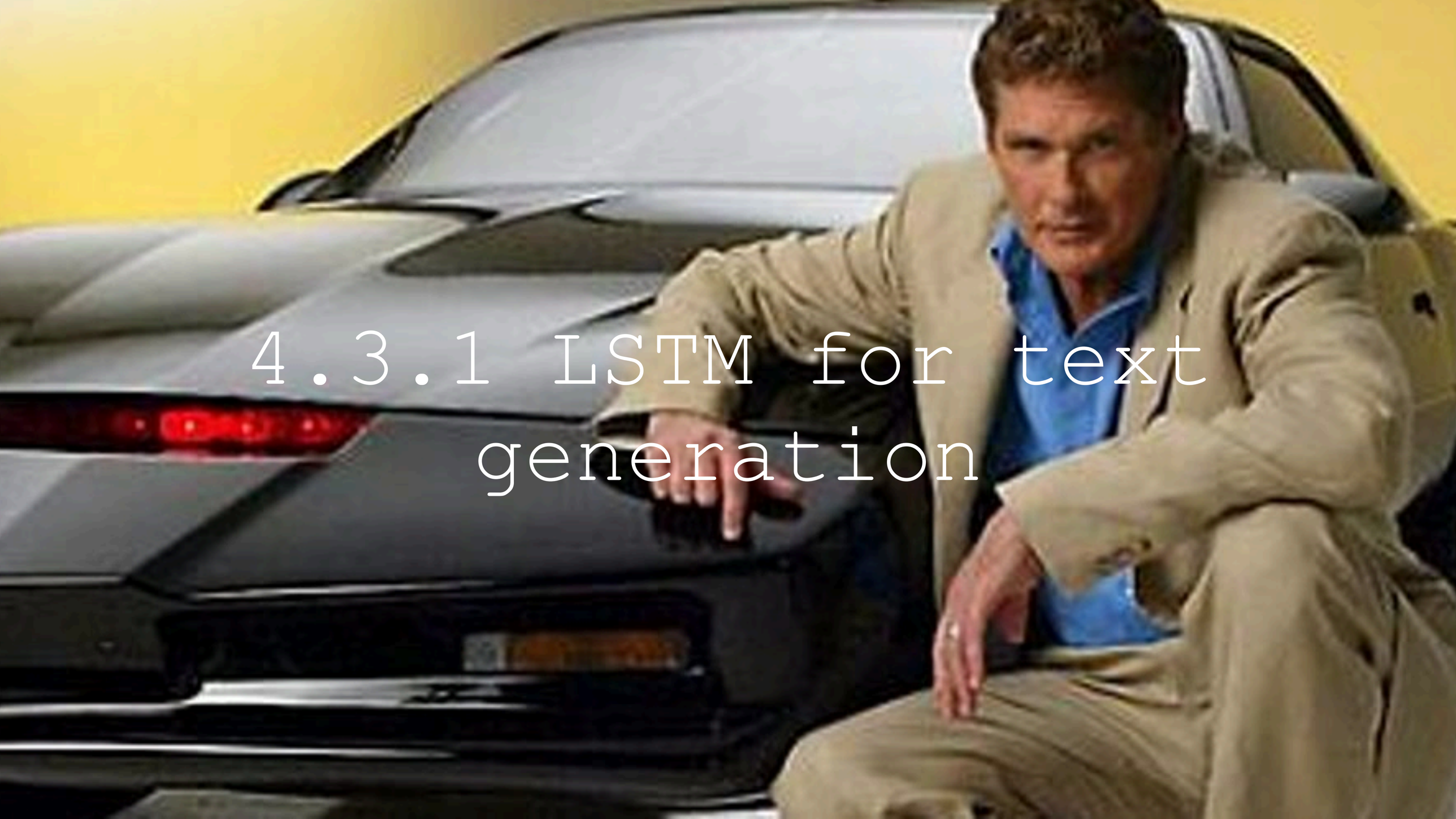
Robert Cohn was once middleweight boxi…

What letter is going to come next?



Save the model's current state and use that as part of our next calcuation.

4.3 Generative Models



4.3.1 LSTM for text generation


4.3.2 DeepDream


4.3.3 Style Transfer

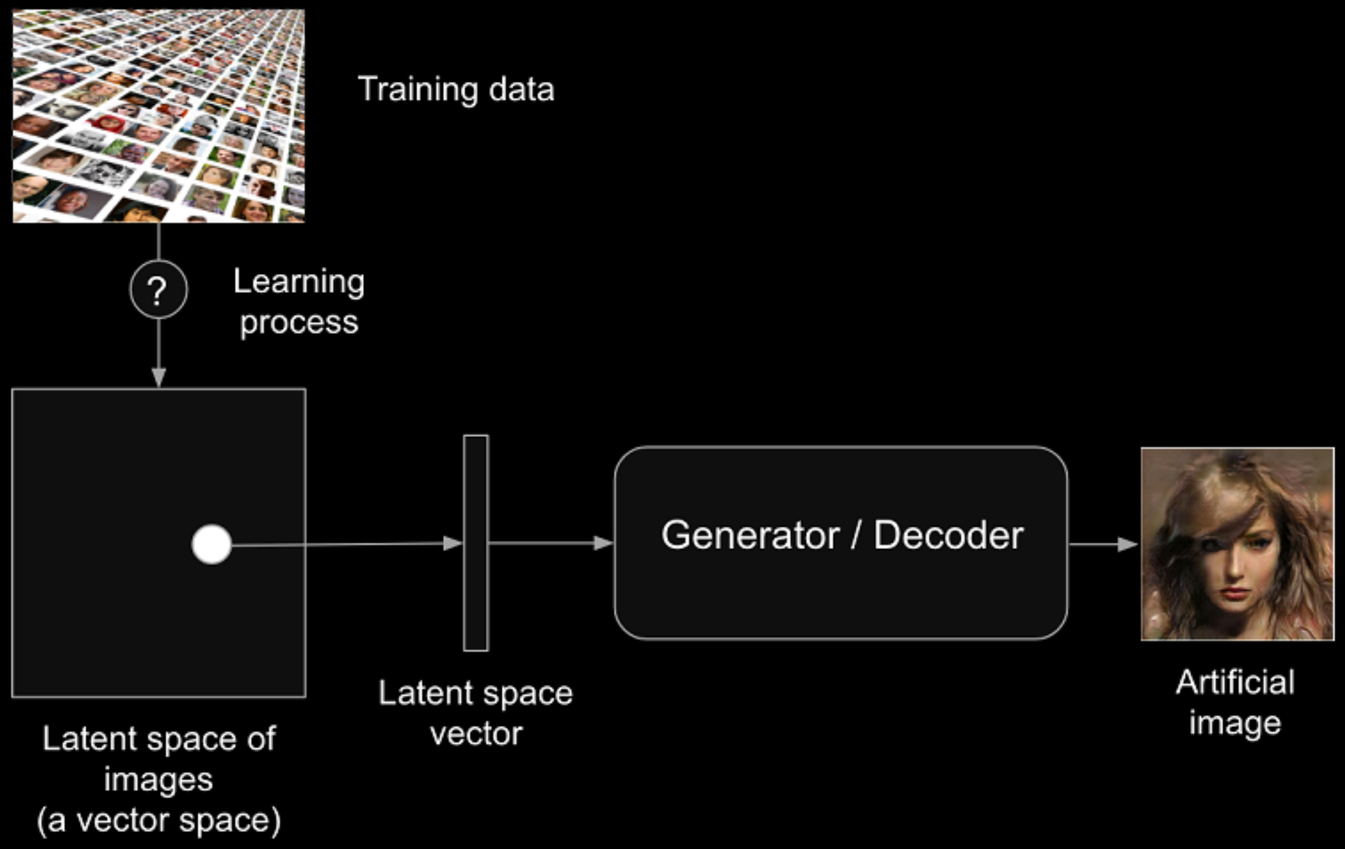
loss =

distance(style(reference_image) - style(generated_image)) +

distance(content(original_image) - content(generated_image))

4.3.4 Auto Encoders

Latent Space



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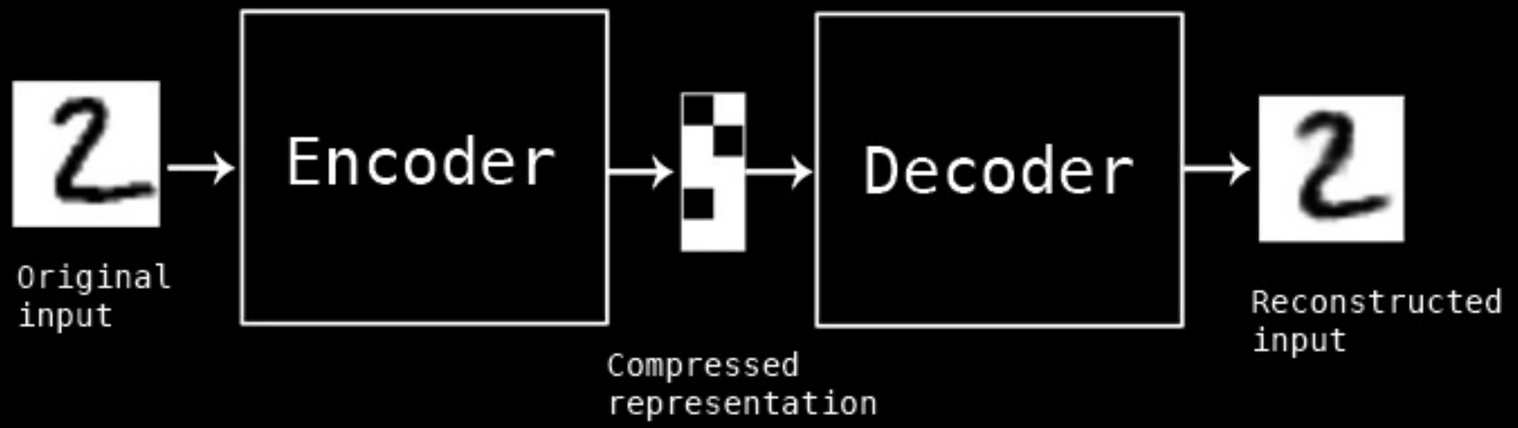
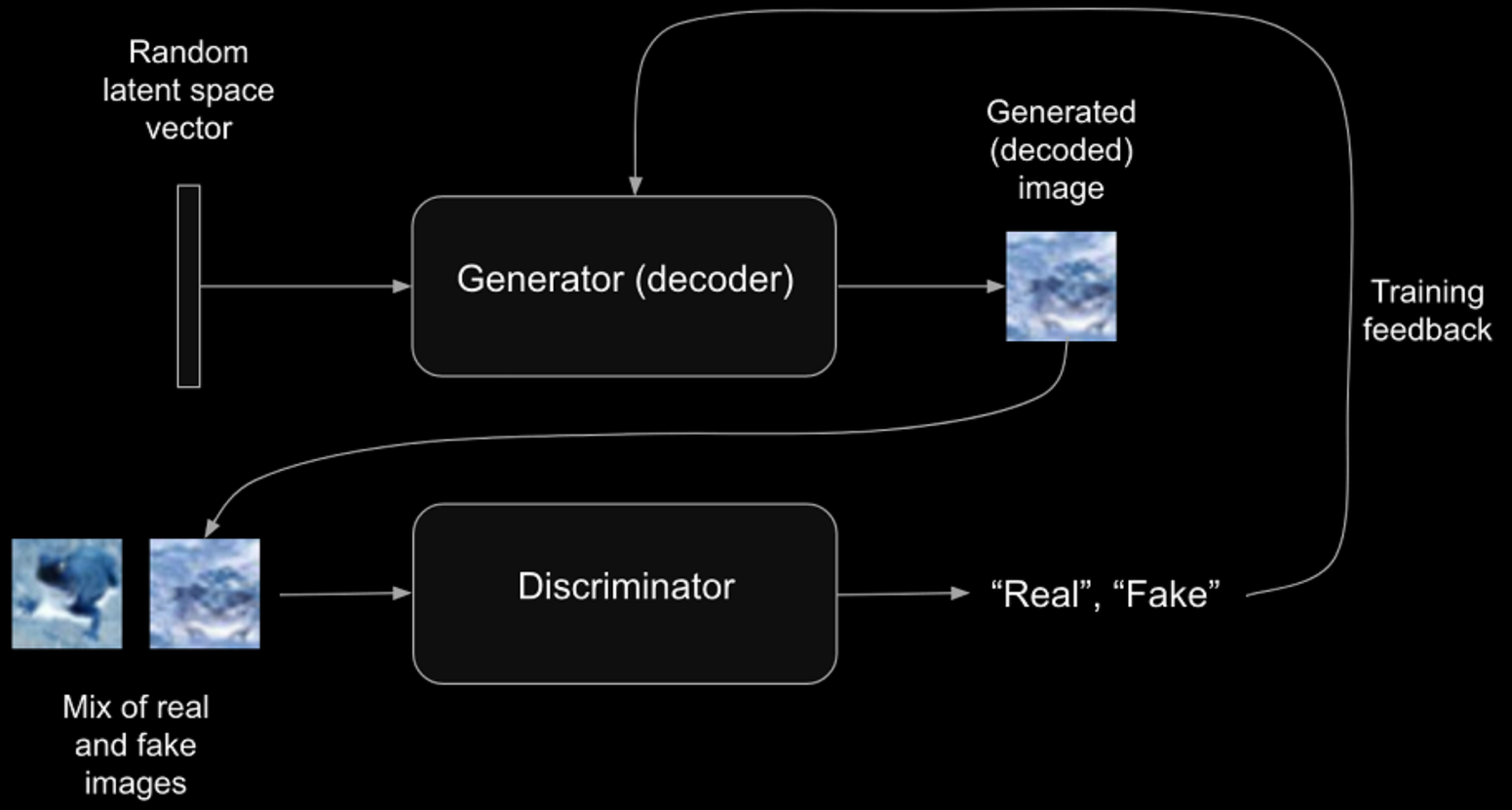
Auto Encoder



(c) Francois Chollet. “Deep Learning with Python MEAP V06.”


4.3.5 GENERATIVE
ADVERSARIAL NETWORKS

GAN



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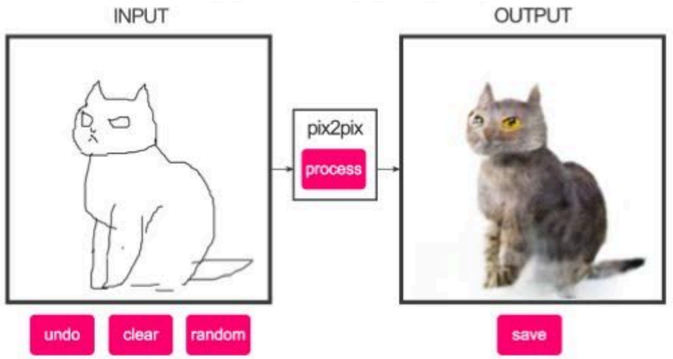
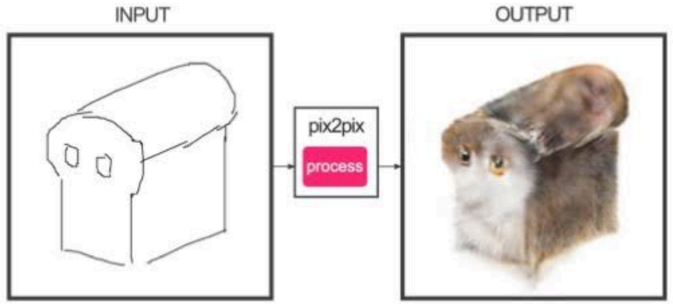
5. ML in Art & Design



@gods_tail



Ivy Tasi @ivymyt

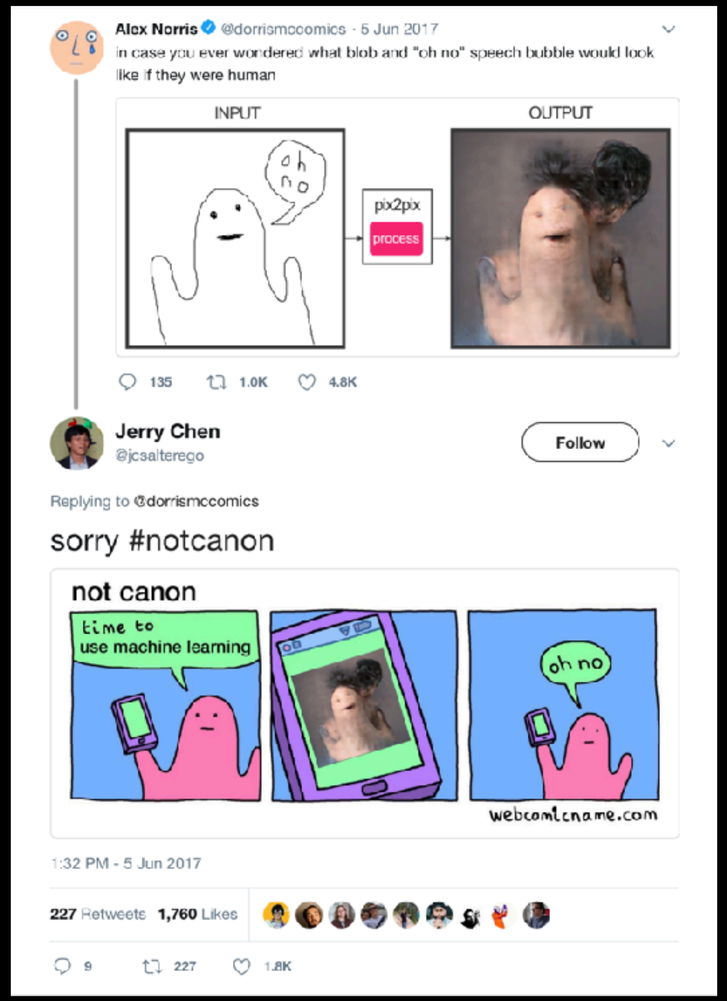
Vitaly Vidmirov @vvid

@ka92

GAN - PIX2PIX etc…

- https://affinelayer.com/pixsrv/index.html / https://affinelayer.com/pix2pix/index.html
- https://ml4a.github.io/guides/Pix2Pix/
- https://vimeo.com/260612034
- https://twitter.com/quasimondo
- https://twitter.com/glagolista
- https://twitter.com/DrBeef_/status/978406962147684352
- Wavenet
- DeepFake
- ofxMSATensorFlow/example-pix2pix

GAN - PIX2PIX etc…



CONVNET

- https://medium.com/@kcimc/a-return-to-machine-learning-2de3728558eb
- http://imaginarysoundscape2.qosmo.jp/
- https://experiments.withgoogle.com/ai
- 201803-Instamona
- KPII-ObjectsViewer-tsne_grid_objects_(2xA4)01_big.jpg

LSTM-RNN

- KPIV-StuckInTraining
- https://medium.com/artists-and-machine-intelligence/adventures-in-narrated-reality-6516ff395ba3
- https://medium.com/artists-and-machine-intelligence/adventures-in-narrated-reality-part-ii-dc585af054cb
- https://medium.com/@samim/generating-stories-about-images-d163ba41e4ed
- https://www.robinsloan.com/voyages-in-sentence-space/
- midiGenerator_v1 + neuralmetal (example of scrapping + training + deploying)
- ofxMSATensorFlow/example-char-rnn

6. Workshop

Introduction

- Wekinator *(see readme on GitHub)*
- ML5js *(see readme on GitHub)*
- Brain.js *(see readme on GitHub)*
- Tensorflow.js *(see readme on GitHub)*
- ML4A OFX *(see readme on GitHub)*
- OFXMsaTensorflow *(see readme on GitHub)*

Misc Ideas

- Image recognition from twitter / instagram feed
- Twitter bot (RNN) using some words or the beginning of some sentence
- Instagram bot searching some specific words
- 'Real time' analysis of youtube videos: gather all objects occurrences
- Videos or images: replace all occurrences of one object with something else
- Generative computer level RNN
- Object detection ConvNets (example ML is fun)
- Generate website layout based on drawing
- Rock, Paper, Scissors
- Live Drawing + style transfer
- Different drawing trigger different events
- Draw something that look like a … (use google doodle dataset)
- LSTM level generator

Resources - Wekinator

- Quick Start Pack
- Facetracker OSC
- Processing libraries:
  - Sprite game
  - Box2D 2D physics
  - PixelFlow performance GPU-Computing (GLSL)
  - Minim Audio
  - OpenCV OpenCV
  - Geomerative 2D geometry
  - ttslib Text2Speech

Resources - JS

- Simple html canvas game
- Simple snake game
- Big list of game
- Says.js tts
- Particles.js Particles
- Anime js Animation engine

Resources - Openframeworks

- Ask me :)

References

- https://distill.pub/
- https://ml4a.github.io/
- ML is fun
-