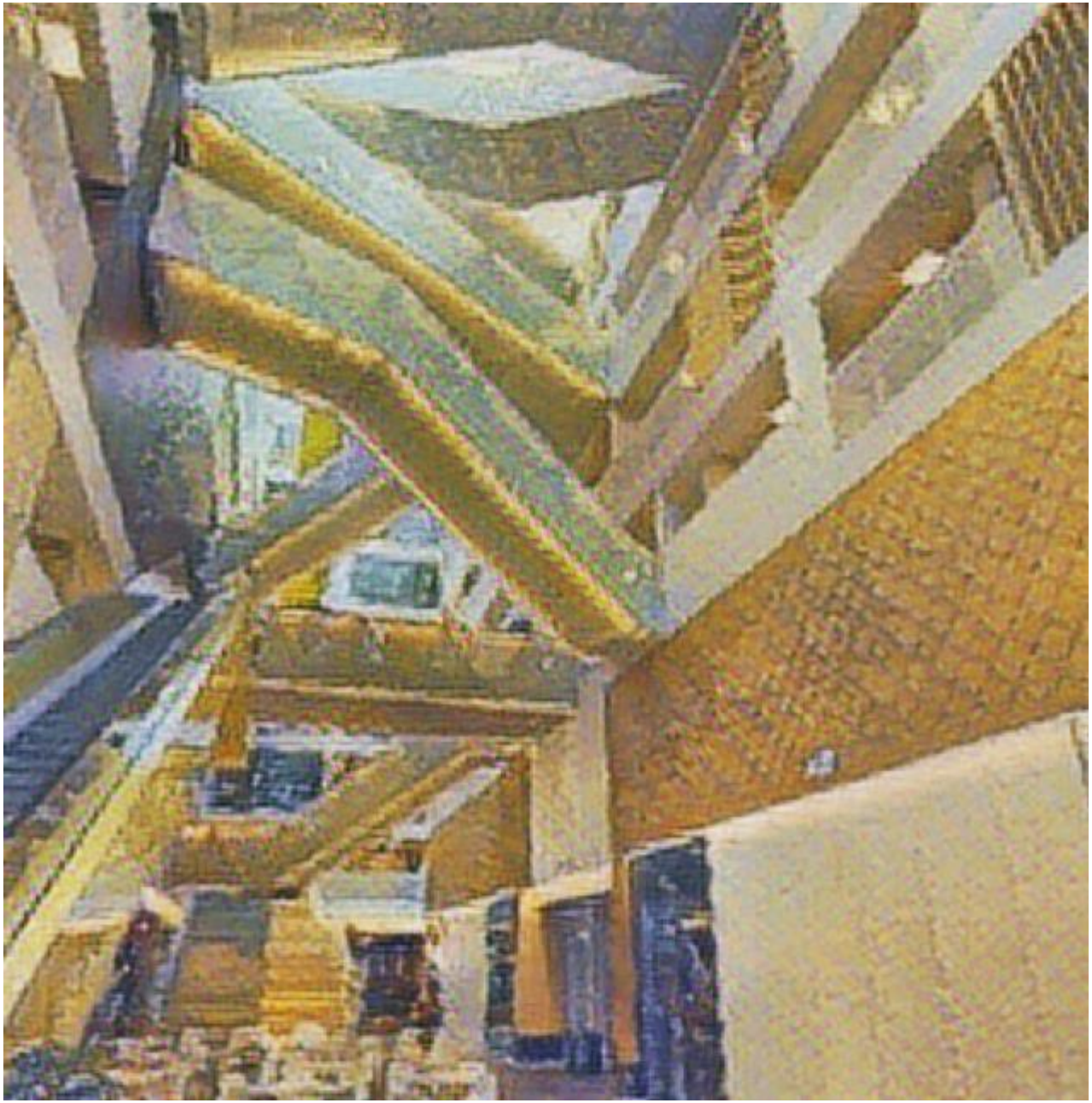
HOGESCHOOL UTRECHT

Fundamentals of Machine Learning

Week 8: Neural networks, AI & creativity

Working on final project

Jonas Moons



Program

- 0-1.5 hours: short lecture
  - Neural networks, AI & creativity
- >1.5 hours: project supervision / help in small groups
- Participants in AI research project get separate supervision next week

Notices

- Presentation next week will be online in Gather (gather.town)
- You will more information via mail/Canvas
- Type "pip install tensorflow" in console

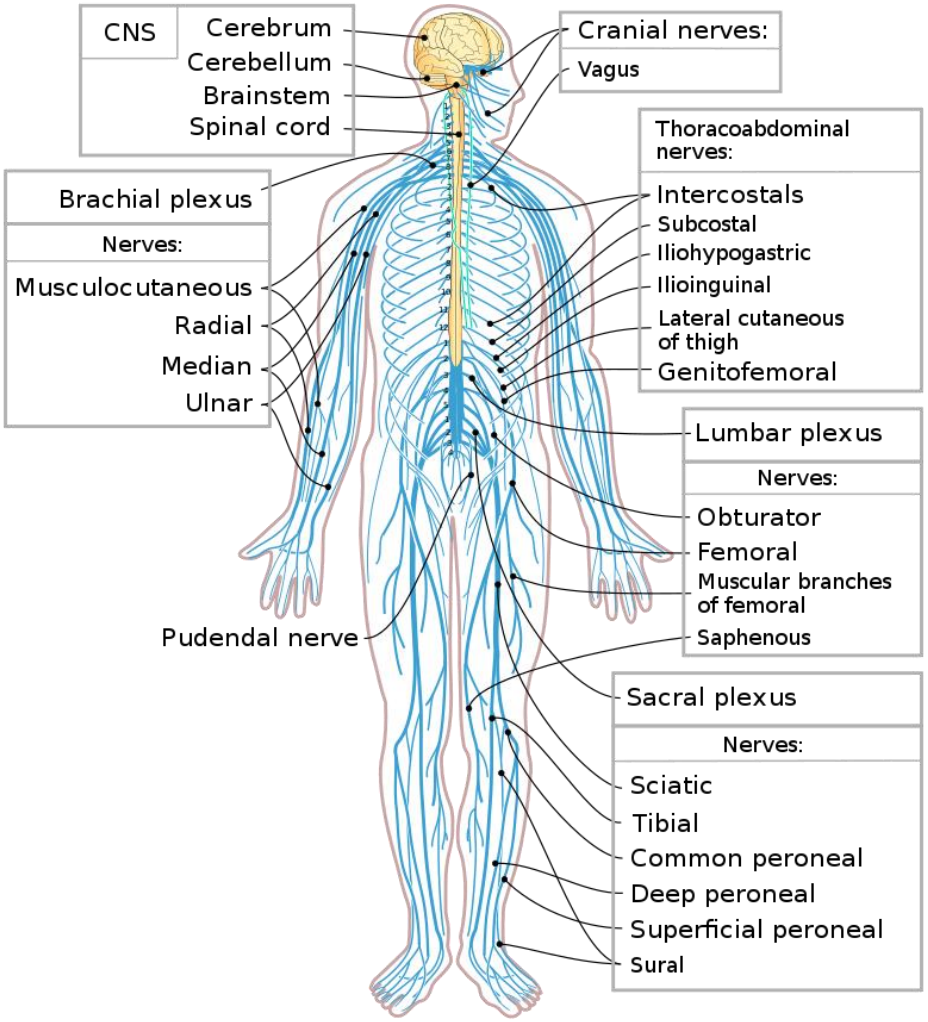
Asking questions

- Ask coding questions via Teams channel, not via chat
- Give enough context: what did you try, what did you Google, code snippet
- I might help out but I can't promise unfortunately
- Please help each other out!

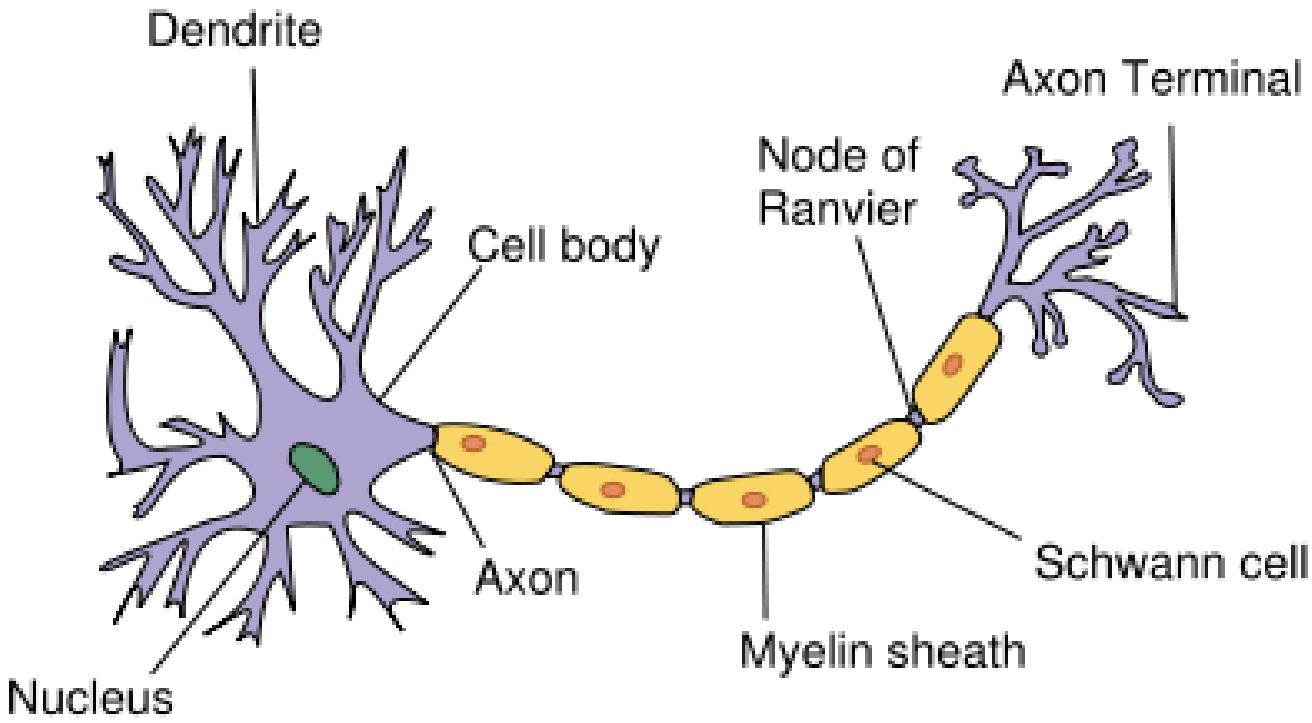
What is a neural network?

- A machine learning technique *inspired* by the brain
- Some overlap but more differences
- Features:
  - Many small computational units…
  - That are connected through links…
  - Which become weaker/stronger through feedback…
  - And represent structure at different levels of abstraction

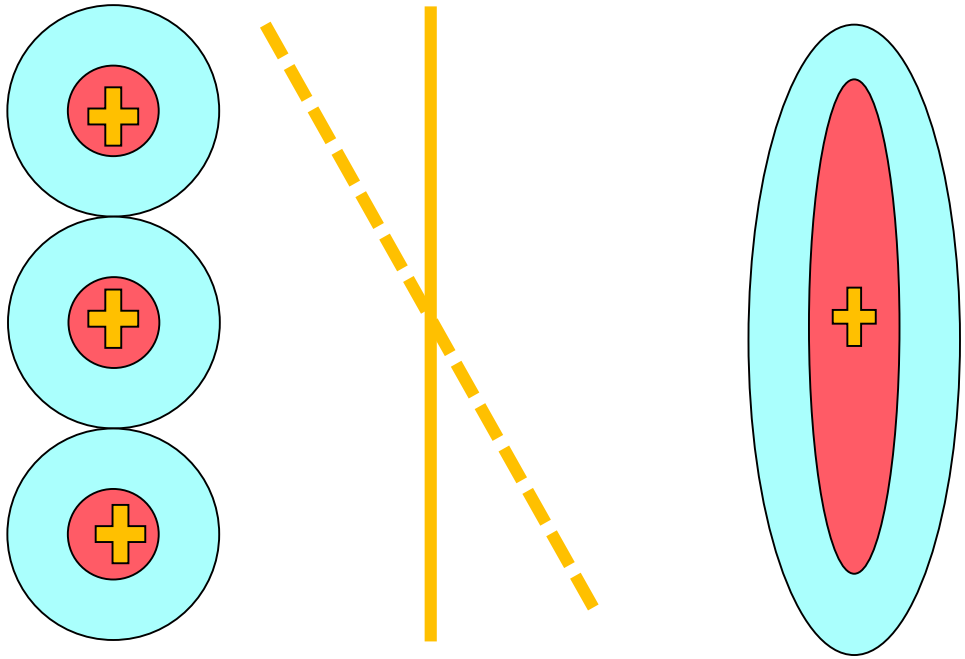
Nervous system



Neuron


Dendrite
Axon Terminal
Node of
Ranvier
Cell body
Schwann cell
Axon
Myelin sheath
Nucleus

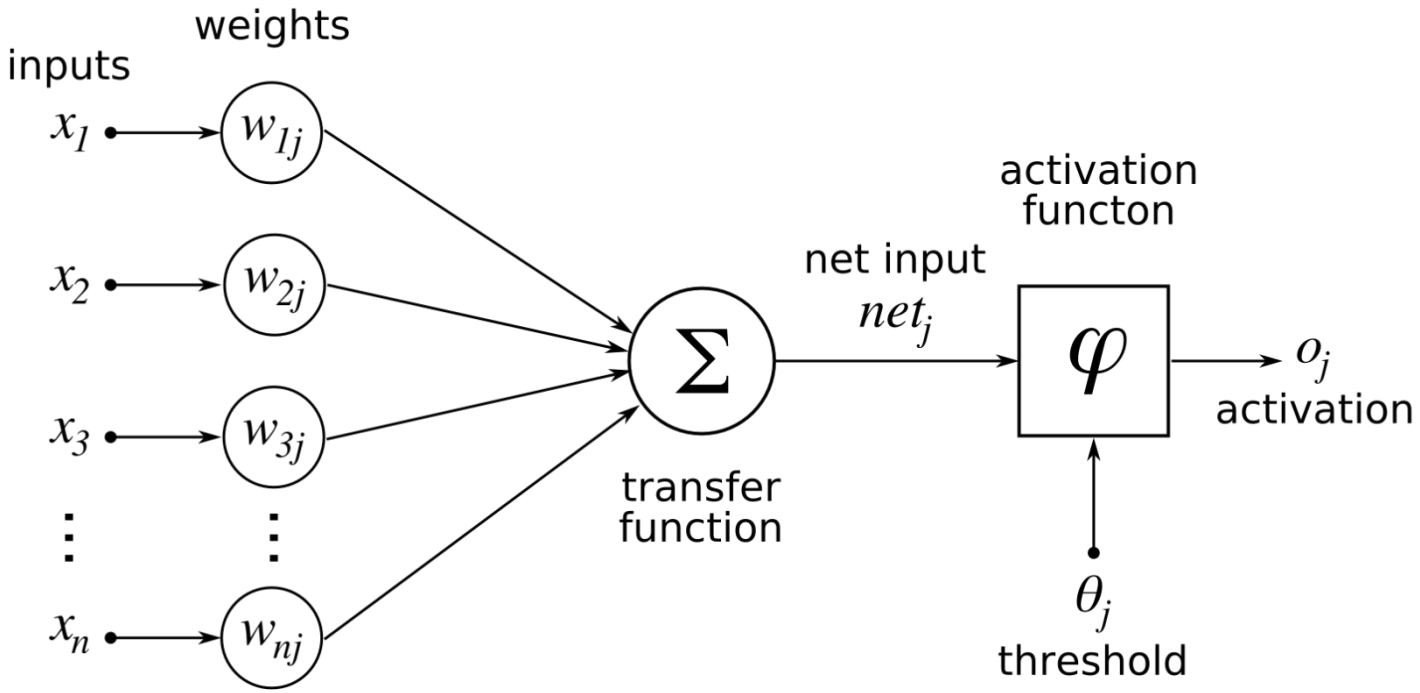
Visual perception



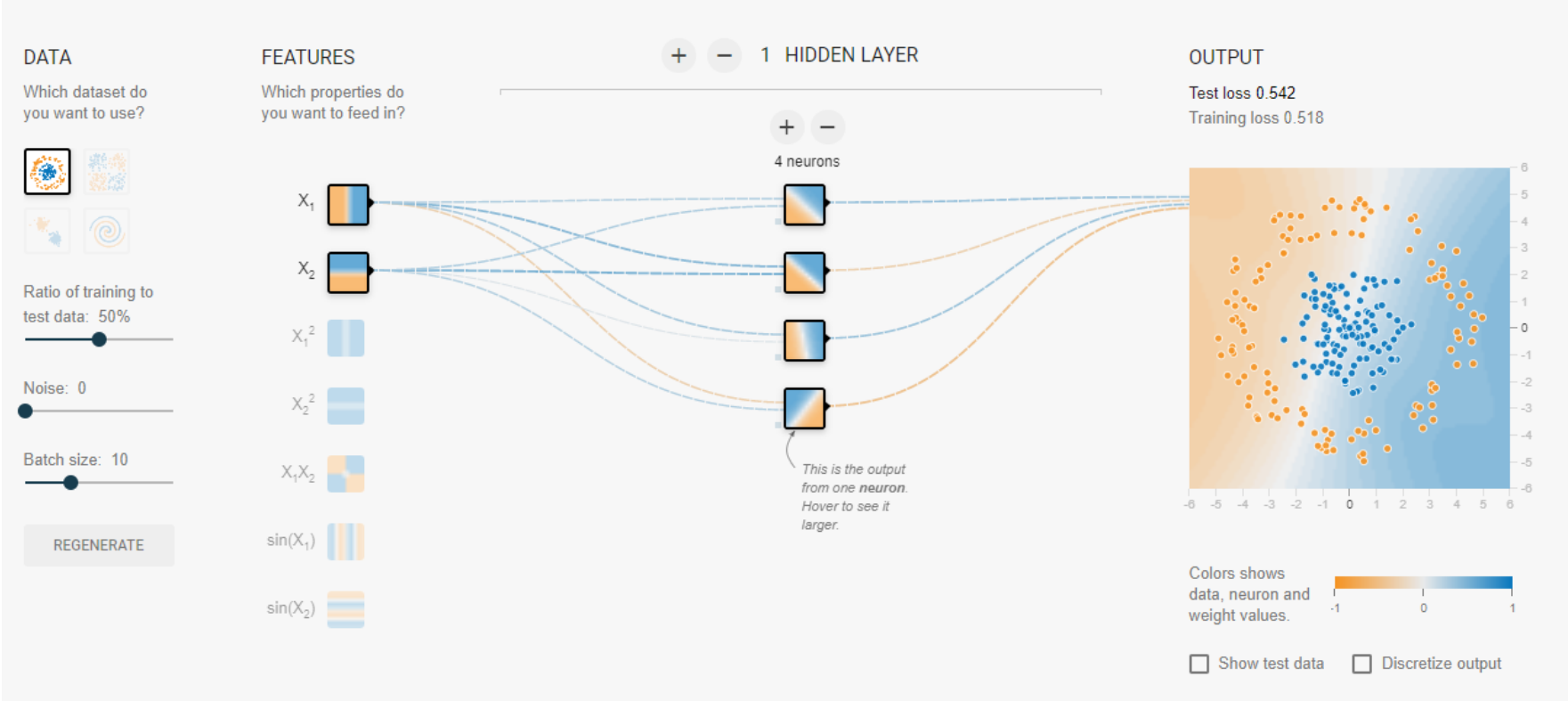
Ganglion cell (in retina)

Simple cell (in visual cortex)

Artificial neural network



Sandbox


DATA
Which dataset do you want to use?
Ratio of training to test data: 50%
Noise: 0
Batch size: 10
REGENERATE
FEATURES
Which properties do you want to feed in?
X1
X2
X1²
X2²
X1X2
sin(X1)
sin(X2)
1 HIDDEN LAYER
4 neurons
This is the output from one neuron. Hover to see it larger.
OUTPUT
Test loss 0.542
Training loss 0.518
Colors shows data, neuron and weight values.
Show test data
Discretize output

Exercise 1

Go to the neural network playground

1. Start with a neural network with 1 hidden layer and 1 neuron. Train the model. What does the activity of the neuron represent? How do you see this in the lines connecting the input to the neuron?

2. Add another neuron and train. What does each neuron represent? What shape can be detected by the two neurons together?

3. Try again with 3 neurons. How can you see that this is enough for this data set?

4. Try out the spiral data set with different levels of hidden layers, neurons and settings. This one is tricky, see if you can get the neural network to solve it!

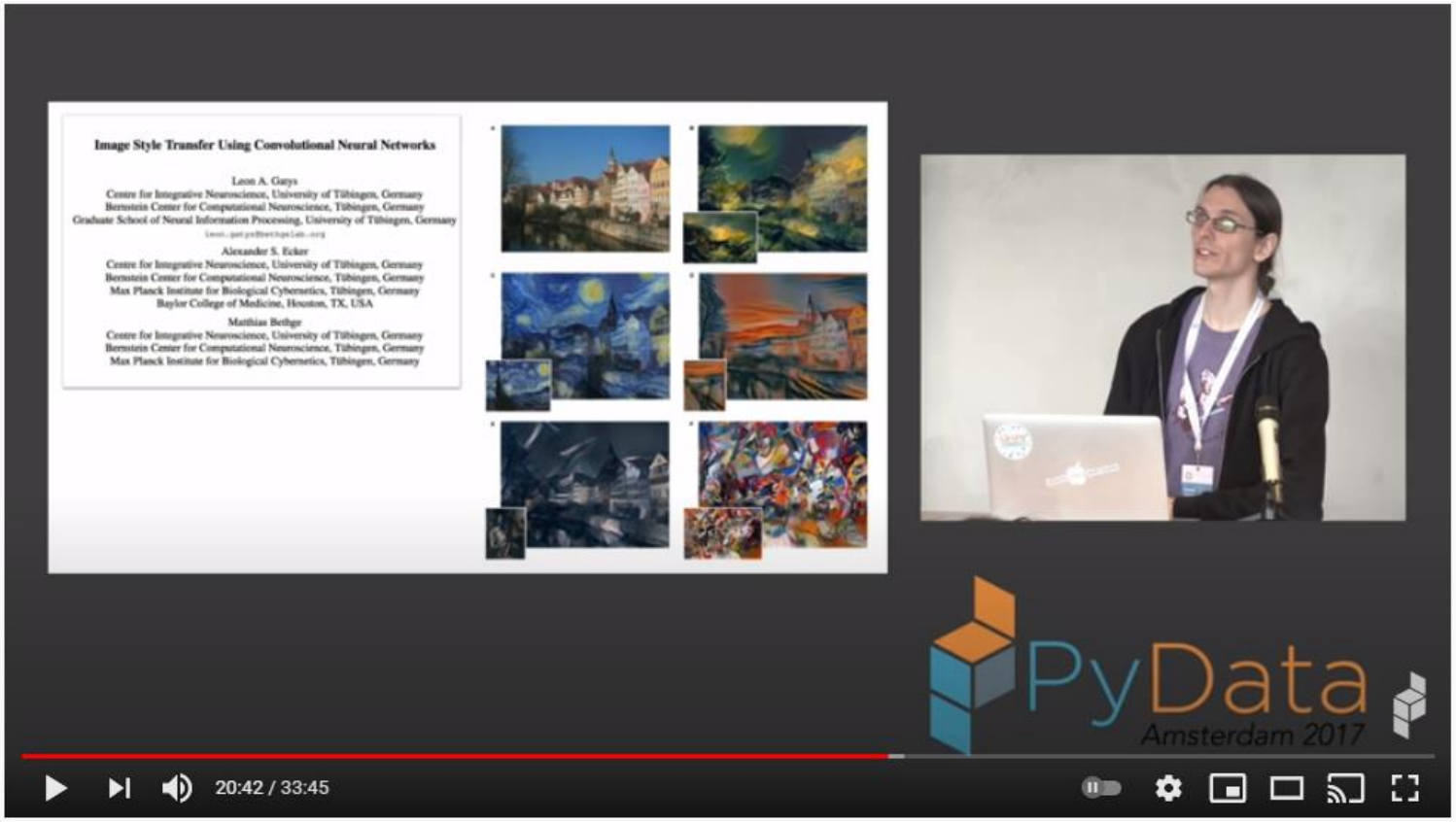
When (not) to use neural networks?

- When values are spatially, temporally and/or structurally correlated
- When structure exists at various levels of abstraction (e.g. pixel, line, edge, surface, object)
- Examples
  - Pixels in image → image recognition
  - Time and frequency in sound → speech recognition
  - Words and sentences → text generation

History of neural networks / deep learning

- 60s: multilayer perceptrons (Ivakhnenko)
- 60-80s: backpropagation algorithm (gradient descent). Rumelhart et al.
- 90s: neural networks fell out of favor
- 00s: back due to more computational power and better algorithms. "Deep Learning"

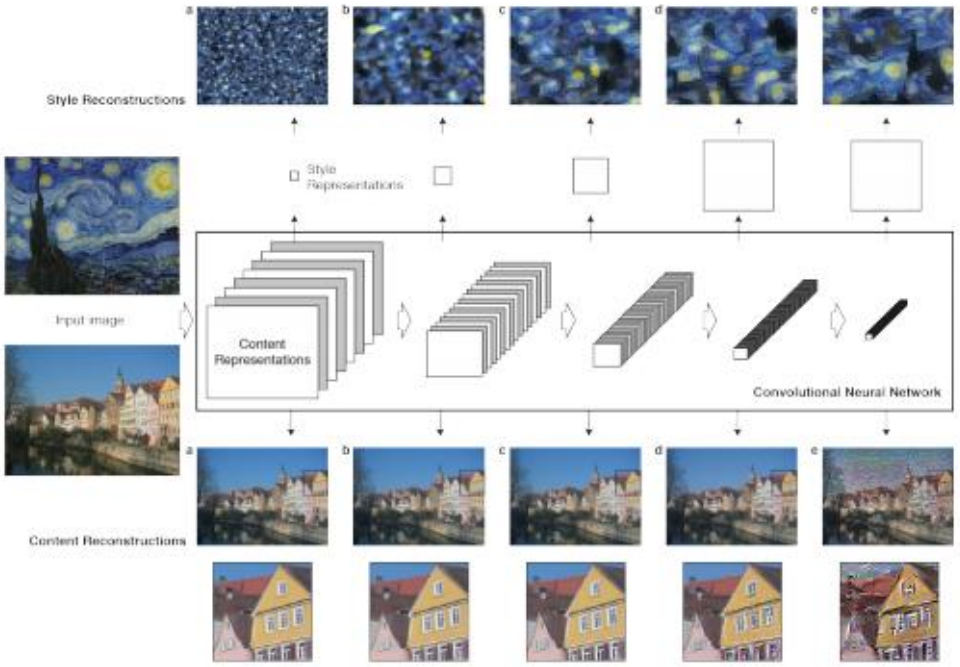
AI and creativity



Video

Style transfer

- Gathys, Ecker, & Bethge (2015)
- Use two neural networks, at different levels of abstraction: content and style



Exercise 2

Taken from https://www.tensorflow.org/lite/models/style_transfer/overview

Find the Notebook on Github and download it.

1. Change the image urls
2. Run the Notebook
3. Upload the result in the Teams channel!

Image credit

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