Implementing ANNs with TensorFlow

Session 04 - TensorFlow

Last Week

Backpropagation

- Last lecture we derived the backpropagation algorithm, which was rather complex math.

- In the homework you implemented the backpropagation algorithm in NumPy, which was probably also quite complex coding.

- The goal was to make you see how TensorFlow is a huge easement.

Agenda

1. Introduction to Deep Learning Frameworks
2. TensorFlow 2.0
3. Hands On

Deep Learning

What is Deep Learning?

- Until now I used the terms artificial neural network and multi-layer perceptron.

- Both are rather “old” terms.

- The success in various applications (as seen in the introduction) is mainly due to deep neural networks (DNNs).

- DNNs is the term for ANNs that have many hidden layers.

- DNN is a more general term as MLP. We will see that in future lectures.

- Deep learning is the term for training a deep neural network.

Deep Learning

- Applied deep learning requires the implementation of a deep neural network on a computer!

- The training is realized via gradient descent, which requires you to calculate and implement the backpropagation algorithm.

- As deep neural networks got more advanced (including novel processing steps) the gradients also get more complex.

- Wouldn’t it be awesome to have a framework that does this automatically?

Deep Learning Frameworks

- This is the goal of deep learning frameworks.
- They allow a simple implementation of a deep neural network.
- And automatically calculate the gradients for you to run gradient descent on the network!

Deep Learning Frameworks

- There are many different ones:

theano

Caffe

mxnet

[w1]

Microsoft Cognitive Toolkit

[w2]

TensorFlow

Deep Learning Frameworks

The battle of the giants:

TensorFlow [w2]

- Developed by Google Brain Team
- Initial release Nov. 2015
- Current Release: TensorFlow 2.0
- Usually used in industry
- Larger community

PyTorch [w1]

- Developed by Facebook AI Research
- Initial release Oct. 2016
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- More and more researchers switch to PyTorch

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The newest release ‘TensorFlow 2.0’ promises to incorporate the advantages of PyTorch. You will learn that!

TensorFlow

TensorFlow 2.0

- We will learn how to use the recently released TensorFlow 2.0.

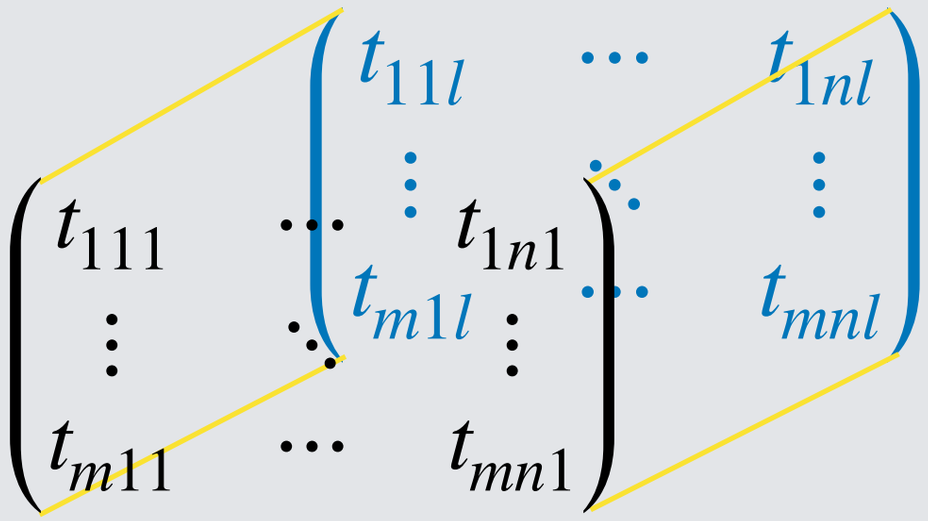
- We will use it inside of Jupyter Notebooks.

- I recommend to use Google Colab (Link). No need to install anything at all. You need a Google account though.

- If you want to setup everything on your own laptop checkout the instructions on the first homework!

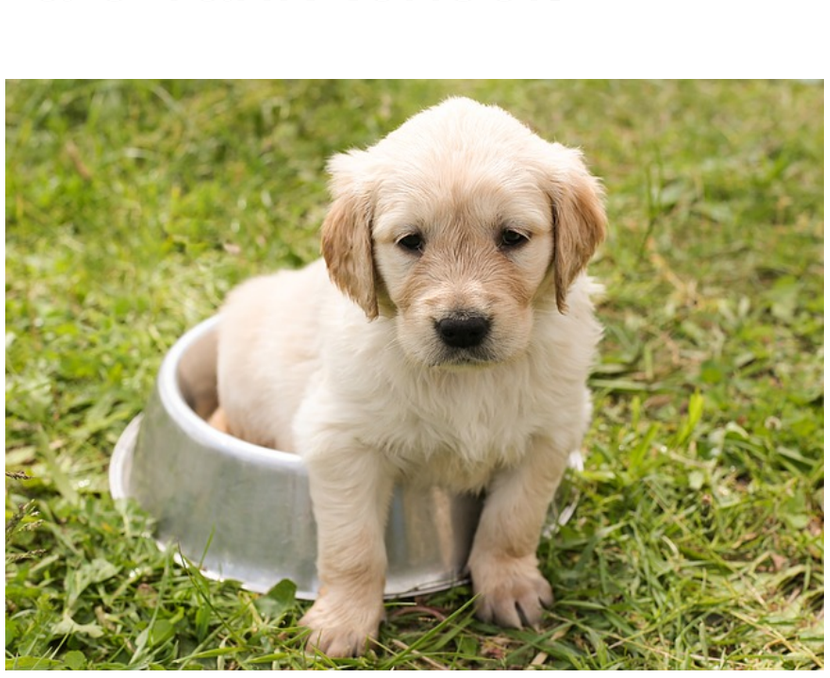
What is a Tensor?

For our purposes a tensor is simply a general term for a high-dimensional array (actually it defines an operation).

Variable	Mathematical Object	Description	N-rank Tensor
x	x	Scalar	0-rank
$\overrightarrow{v}$	$(v_1 \quad \cdots \quad v_n)$	Vector	1-rank
W	$\begin{pmatrix} w_{11} & \cdots & w_{1n} \\ \vdots & \ddots & \vdots \\ w_{m1} & \cdots & w_{mn} \end{pmatrix}$	Matrix	2-rank
T		Tensor	3-rank

Why Tensors?

- In the last lectures and in the homework everything was restricted to vectors and matrices!
- What do we need tensors for?
- This will become clear in future lectures.
- A preview: Colored (RGB-valued) Images are represented as a 3-rank tensor.



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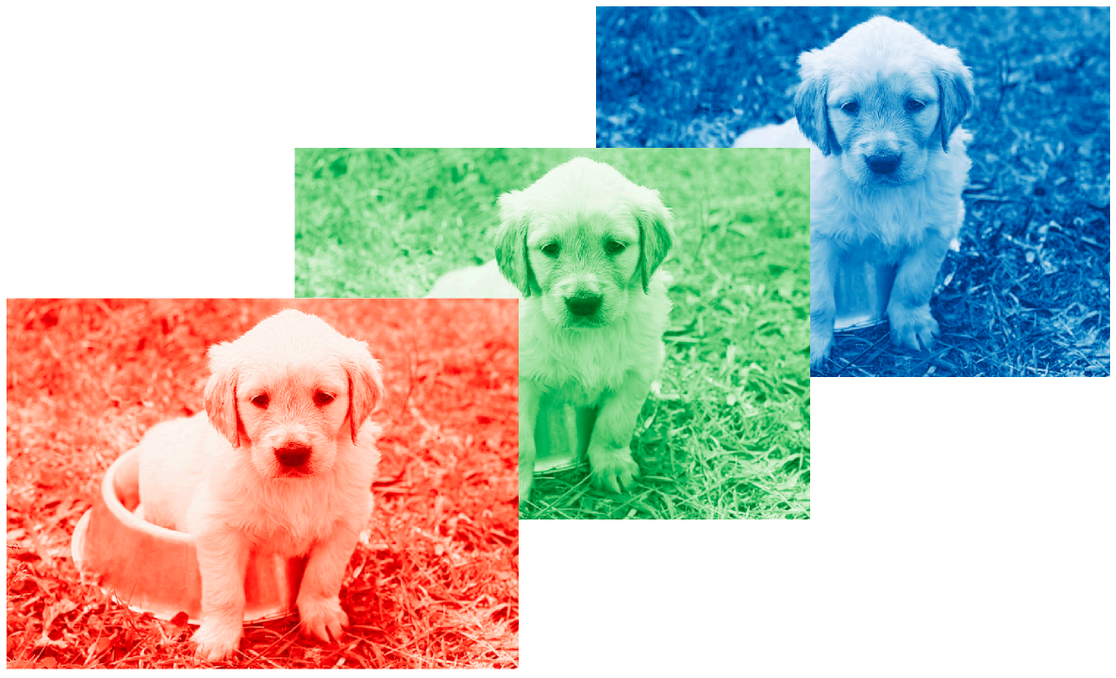

Hands-On

Switch to the Jupyter notebook now!

That’s it!

Resources

[w1] DieserGorilla at Wikipedia (https://de.wikipedia.org/wiki/Datei:Pytorch_logo.png)

[w2] FlorianCassayre at Wikipedia (https://de.wikipedia.org/wiki/Datei:Tensorflow_logo.svg)