EMBEDDED VISION DESIGN 3

TENSORFLOW & KERAS
HANDS-ON

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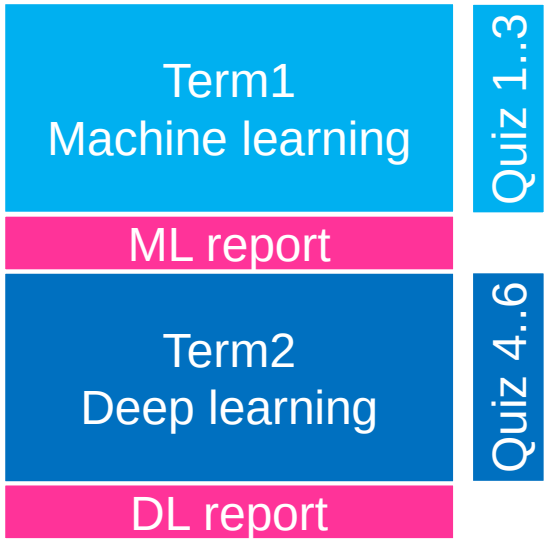
CONTENTS

- Deep learning workshop organization
- Deep learning
- Deep learning frameworks
- Installing TensorFlow 2
- Image classification exercise

ORGANIZATION OF THE WORKSHOP

- Theory with integrated quizzes.
- Hands-on with 2 mini-projects
- Final mark:
  80% ML + DL report,
  20% quiz results
- Live demo or short video clip,
  showing your deployed model



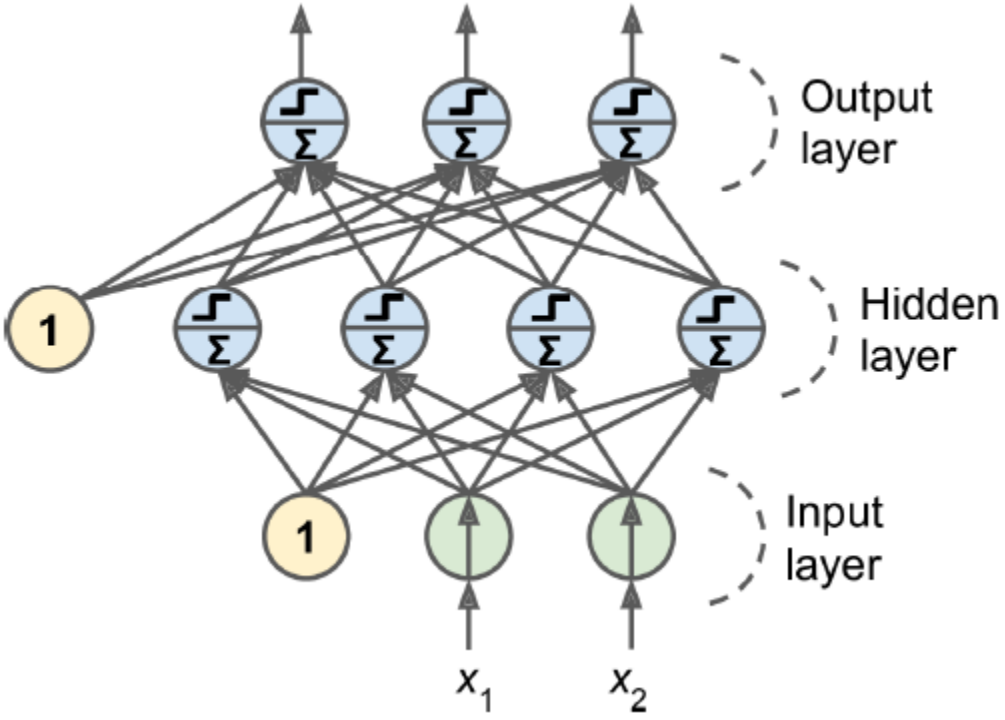
2.1/A	45	08/11/2021	Artifical Neural Network (ANN)	Machine learning vs deep learning Biological neuron Perceptron Multi-layer perceptron (MLP) Backpropagation Regression and classification MLP	Workshop organization Deep learning Frameworks Installing TensorFlow 2 Image classification exercise			279-307	849-858
2.2/B	46	15/11/2021	Training Deep Neural Networks	Vanishing and exploding gradients Transfer learning training optimization Learning rate scheduling Regularization	Data augmentation Walk-through MNIST fashion exercise Tensorboard, visualizing the training process Storing and loading models Fine-tuning neural network hyperparameters		Resit Full ML report	308-373	
2.3/C	47	22/11/2021	Convolutional Neural Network	Visual cortex CNN vs MLP Recap convolution Convolutional layer Pooling layer CNN architecture	Avoiding exploding/vanishing gradients Avoiding overfitting Using the Keras tuner Transfer Learning and Tensorflow hub	4 ANN		445-483	
2.4/D	48	29/11/2021	Advanced CNN	Object detection Object tracking Semantic segmentation Variational autoencoder Edge computing	Implementing a CNN Transfer learning			465, 483-496, 567-591, 586-591	
2.5/E	49	06/12/2021	Guest Speaker	tbd			Preliminary DL report, Ch. 1-3		
2.6/F	50	13/12/2021	Mind and machine Cognitive Science introduction	Mental representations Visual perception Cognitive approach Mind as a web AI	Work on portfolio	5 CNN			
2.7/G	51	20/12/2021	Wrap-up	Work on portfolio	Work on portfolio				
	52	27/12/2021							
	1	03/01/2022							
2.8/H	2	10/01/2022		No class					
2.9/I	3	17/01/2022		No class		resit 4,5	Full report		
2.10/J	4	24/01/2022		No class					

DL PORTFOLIO TEMPLATE

TABLE OF CONTENTS

NEURAL NETWORKS

- Classification



Source: Géron, ISBN: 9781492032632

DEEP LEARNING FRAMEWORKS

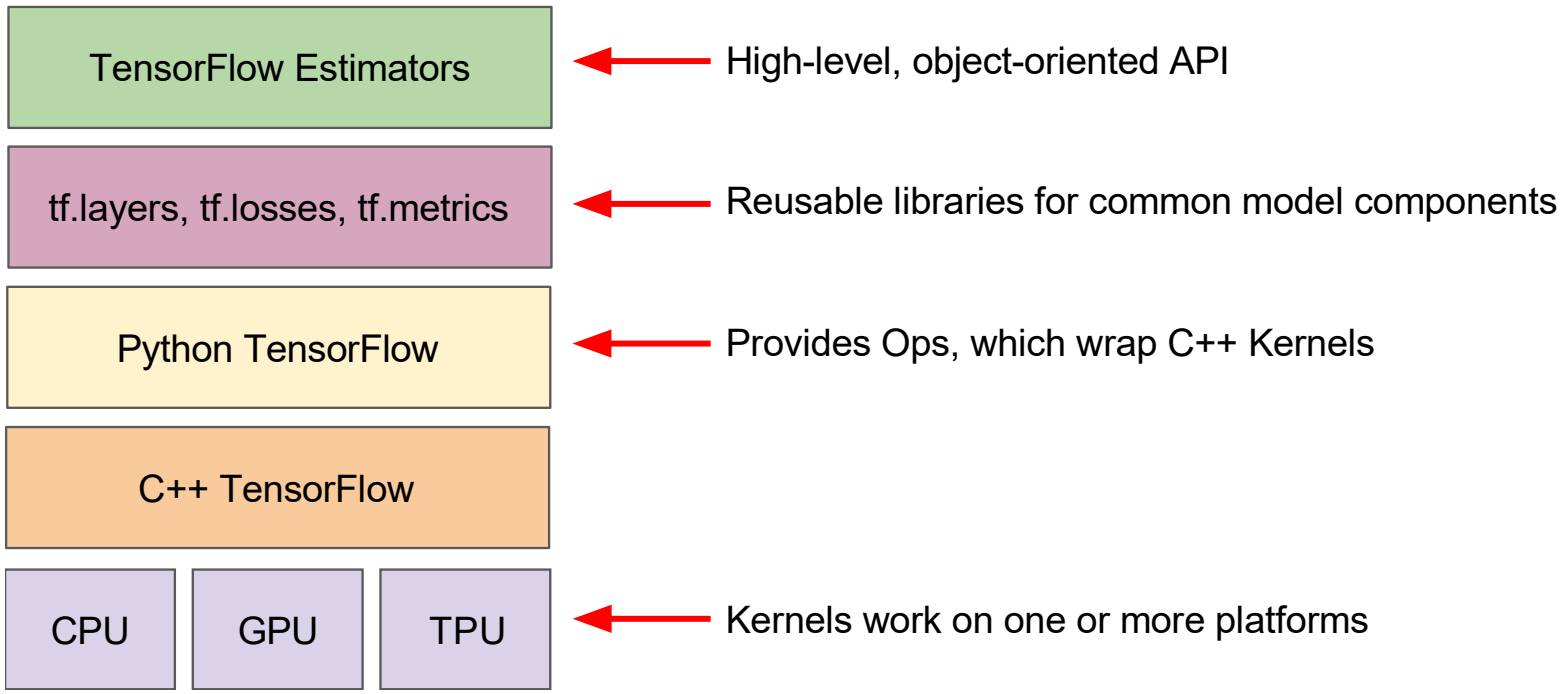
Pro's

- Standardized environment
- Reduce time, costs, complexity of development
- Problem domain specific, e.g. decision support, financial, end-user application, web

Con's

- Steep learning curve
- Inefficient use of resources

TENSORFLOW TOOLKIT



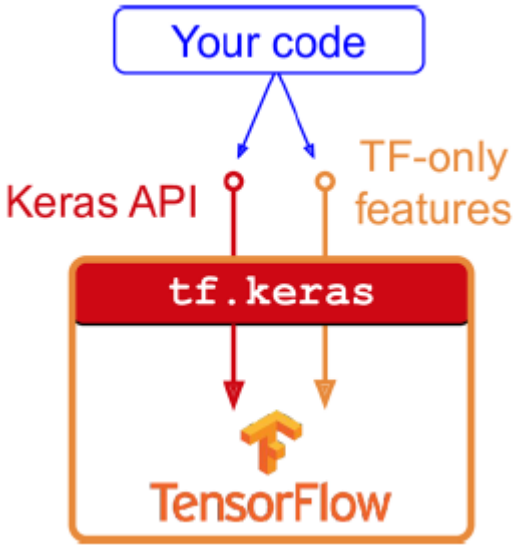
https://developers.google.com/machine-learning/crash-course/first-steps-with-tensorflow/toolkit

KERAS

- Using the TensorFlow framework directly is a lot of hard work.
- Extremely verbose and prone to subtle, hard-to-catch bugs
- Steep learning curve

Solution: use API like Keras (or TFLearn)

- Fast experimentation.
- Capable of running on top of TensorFlow, CNTK, or Theano.



https://datascience.stackexchange.com/questions/25317/what-are-the-pros-and-cons-of-keras-and-tflearn

MORE ON KERAS

- https://www.youtube.com/watch?v=tDaGT4N4aCA&t=141s

INSTALLING TENSORFLOW 2

- https://www.tensorflow.org/install

```
$ python3 -m pip install --upgrade tensorflow
```

For GPU support, at the time of this writing you need to install `tensorflow-gpu` instead of `tensorflow`, but the TensorFlow team is working on having a single library that will support both CPU-only and GPU-equipped systems. You will still need to install extra libraries for GPU support (see *https://tensorflow.org/install* for more details). We will look at GPUs in more depth in Chapter 19.

To test your installation, open a Python shell or a Jupyter notebook, then import TensorFlow and tf.keras and print their versions:

```
>>> import tensorflow as tf
>>> from tensorflow import keras
>>> tf.__version__
'2.0.0'
>>> keras.__version__
'2.2.4-tf'
```

KERAS SEQUENTIAL MODEL

- https://www.youtube.com/watch?v=qFJeN9V1ZsI&t=401s
  up to 10:30

- Terminology:
  x = samples = input data
  y = labels = target data = classes

- https://www.youtube.com/watch?v=qFJeN9V1ZsI&t=1150s
  up to 23:27

- https://www.youtube.com/watch?v=qFJeN9V1ZsI&t=1508s
  up to 29:33

EXERCISE: BASIC IMAGE CLASSIFICATION

- https://www.tensorflow.org/tutorials/keras/classification
- Train a shallow net, see also Géron pp. 297-307
- Trouble downloading the datasets? Let me know
- Training can take quite some time…
  - >> Use a small number of weights in the hidden layers
  - >>Work on colab.research.google.com
- Train and validate (see Géron p. 303)!

Instead of passing a validation set using the `validation_data` argument, you could set `validation_split` to the ratio of the training set that you want Keras to use for validation. For example, `validation_split=0.1` tells Keras to use the last 10% of the data (before shuffling) for validation.

EXERCISE: CONFUSION MATRIX

- Hint 1:
  The model returns probabilities, find the most probable class using np.argmax(…., axis=1)

- Hint 2:
  from sklearn.metrics import confusion_matrix

REFERENCES

- http://tflearn.org/
- https://www.tensorflow.org/
- https://keras.io/
- https://www.tensorflow.org/tensorboard/
- https://developers.google.com/machine-learning/crash-course/ml-intro
- https://developers.google.com/machine-learning/glossary/tensorflow