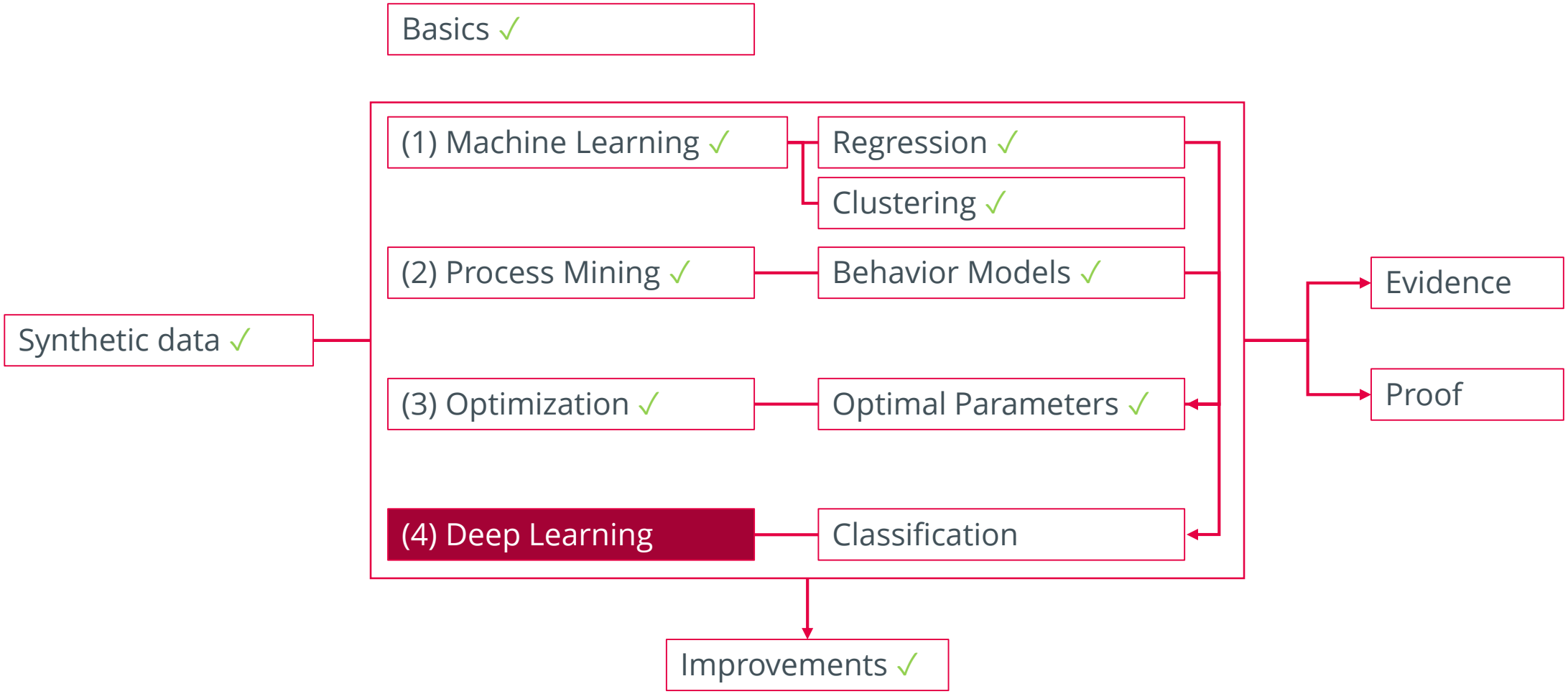
TECHNISCHE HOCHSCHULE
OSTWESTFALEN-LIPPE
UNIVERSITY OF
APPLIED SCIENCES
AND ARTS

Welcome

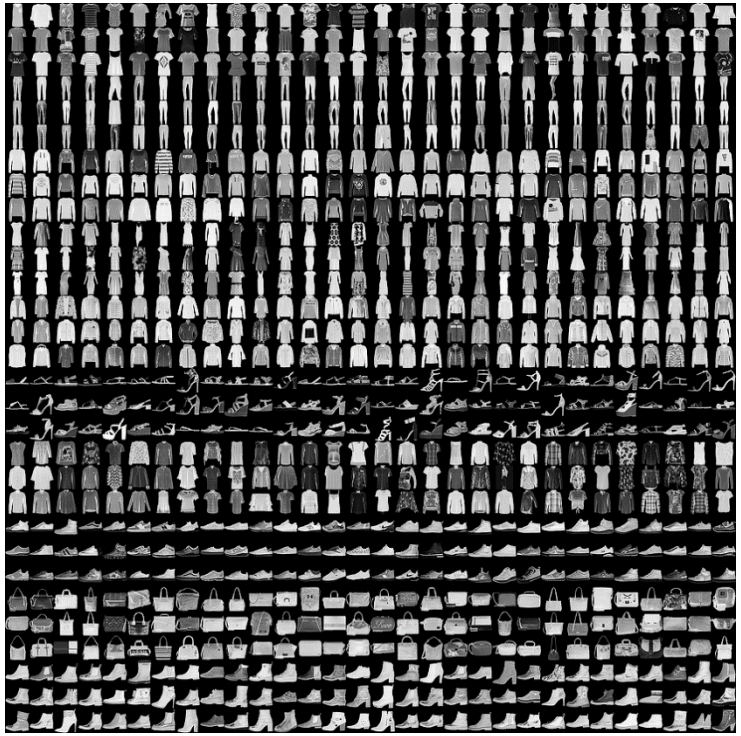
to Advanced Topics in Algorithms

Summary: Advanced Topics in Algorithms

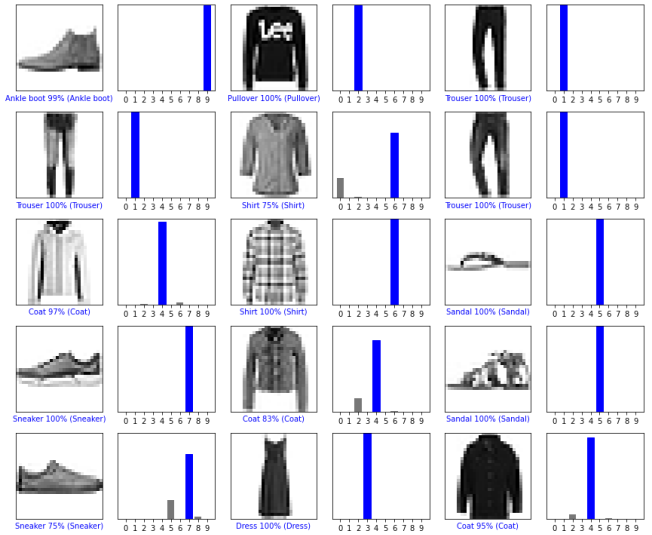


Revision: [Deep] Learning: Classification

Fashion-MNIST is a dataset of Zalando's article images



https://arxiv.org/pdf/1708.07747.pdf



XIAO, Han; RASUL, Kashif; VOLLGRAF, Roland. Fashion-mnist: a novel image dataset for benchmarking machine learning algorithms. *arXiv preprint arXiv:1708.07747*, 2017.

Revision: Neural Network Models

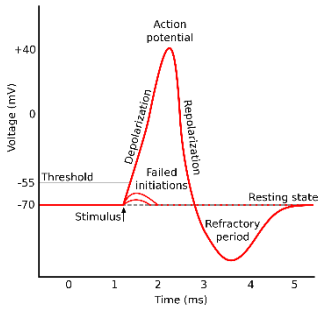
Multi-layer Perceptron (MLP)
MLP is a supervised learning algorithm that learns a function $f(\cdot): R^m \rightarrow R^o$ by training on a dataset, where m is the number of dimensions for input and o is the number of dimensions for output [1].

Set of Features	Target
$X = x_1, x_2, \ldots, x_m$	y

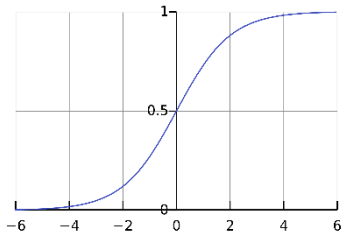
→ MLP can learn a non-linear function approximator for either classification or regression → $f(\cdot)$

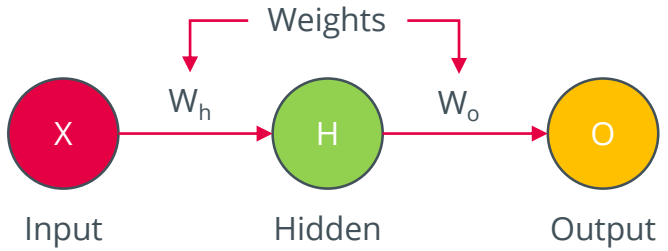
Neurons

Action Potential



Sigmoid Function





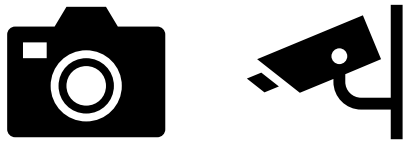
$f(X) = a(a(XW_h)W_o)$

a = activation function

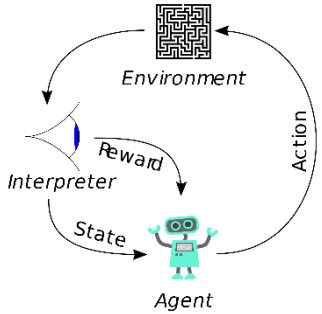
[1] https://scikit-learn.org/stable/modules/neural_networks_supervised.html
[2] https://en.wikipedia.org/wiki/Action_potential#/media/File:Action_potential.svg
[3] https://en.wikipedia.org/wiki/Sigmoid_function#/media/File:Logistic-curve.svg

Use Cases

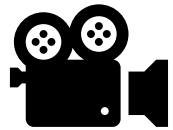
Computer Vision



Reinforcement Learning



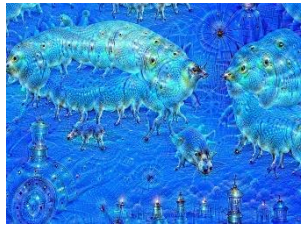
Structured Data



Show top 10 movie recommendations to a user

Natural Language Processing

Generative Deep Learning



DeepDream

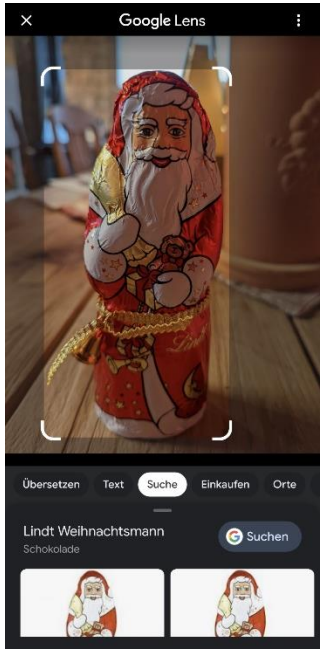
https://keras.io/api
https://mediapipe.dev
https://coral.ai/examples
https://en.wikipedia.org/wiki/Reinforcement_learning#/media/File:Reinforcement_learning_diagram.svg
https://de.wikipedia.org/wiki/DeepDream#/media/Datei:Aurelia-aurita-3-0009.jpg

Use Cases: Computer Vision

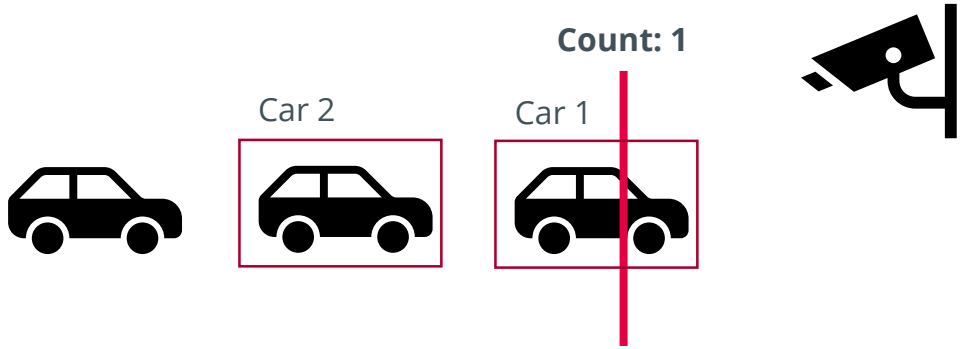
Pose Estimation
https://experiments.withgoogle.com/move-mirror

Image Classification
https://teachablemachine.withgoogle.com

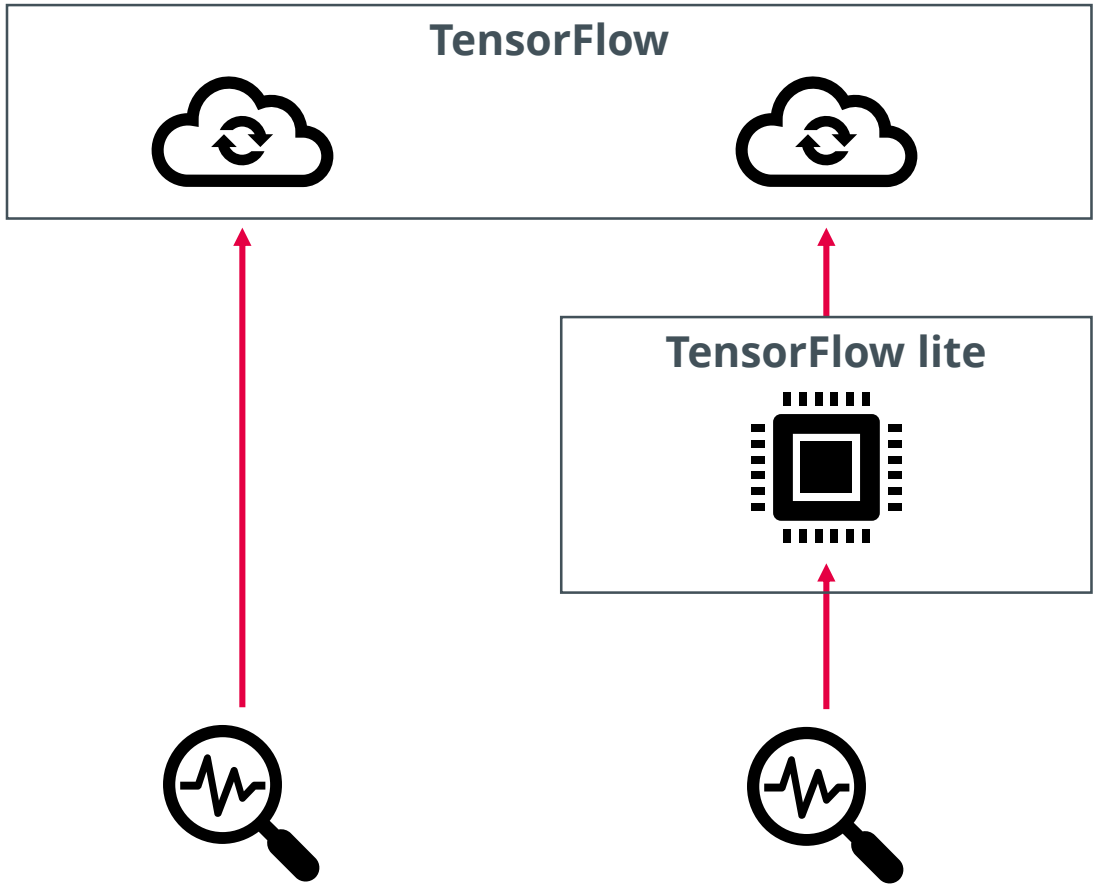
Segmentation



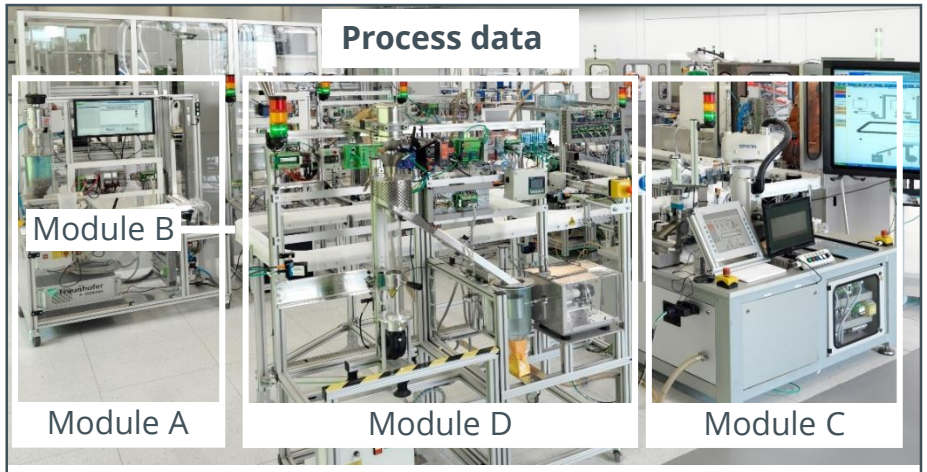
Object Tracking



Integration



privacy



Cyber-Physical Production System (CPPS)

TensorFlow.js

TensorFlow Lite for Microcontrollers

Core runtime fits in 16 KB on an Arm Cortex M3

https://coral.ai
https://www.tensorflow.org/lite/microcontrollers

Data Sets

Examples

- https://www.kaggle.com/datasets
- https://www.kaggle.com/smartfactoryowl
- https://archive.ics.uci.edu/ml/datasets.php
- https://www.openml.org
- https://knowyourdata-tfds.withgoogle.com
- https://cocodataset.org

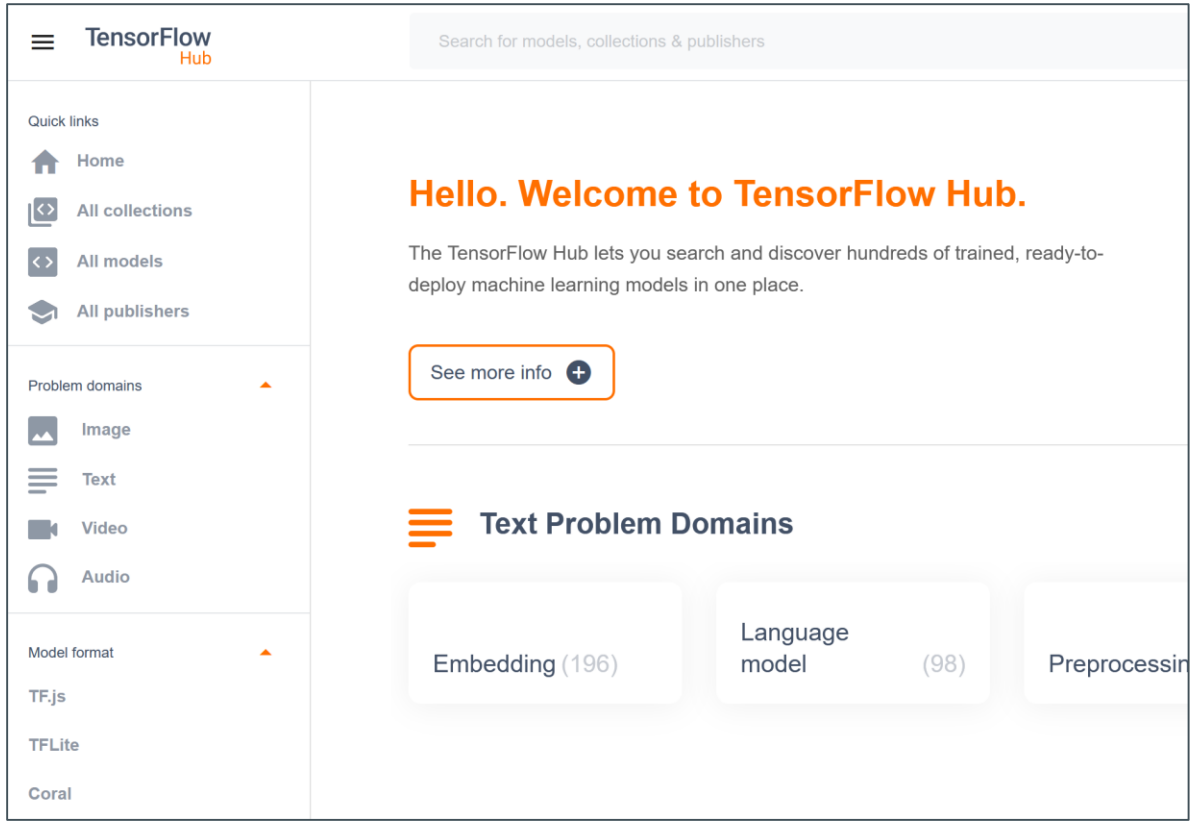
https://cocodataset.org/#explore

COCO is an object detection, segmentation, and captioning dataset and has several features:

- Object segmentation
- Recognition in context
- Superpixel stuff segmentation
- 330K images (>200K labeled)
- 1.5 million object instances
- 80 object categories
- 91 stuff categories
- 5 captions per image
- 250,000 people with keypoints

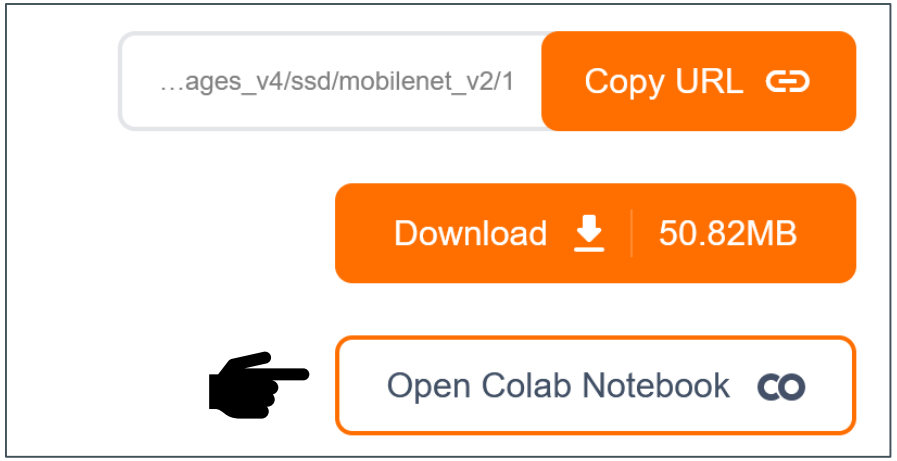
LIN, Tsung-Yi, et al. Microsoft coco: Common objects in context. In: *European conference on computer vision*. Springer, Cham, 2014. S. 740-755.

Pretrained Models



Example

SSD-based object detection model trained on Open Images V4 with ImageNet pre-trained MobileNet V2 as image feature extractor.



https://tfhub.dev/

Transfer Learning

Transfer learning consists of taking learned weights and leveraging them on a new problem

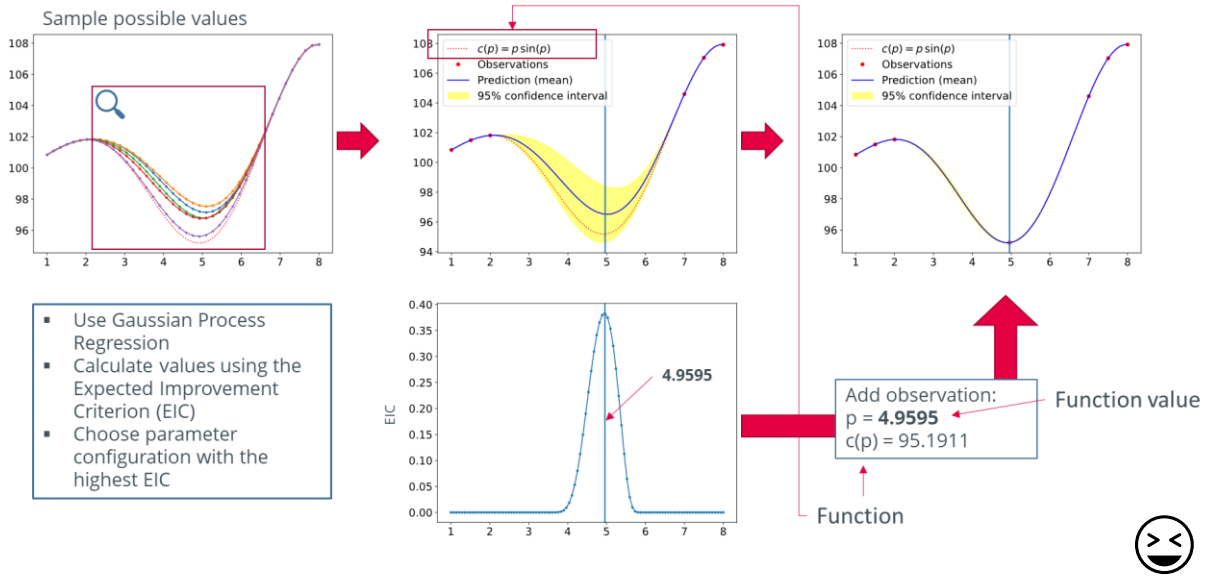
1) Take weights from a previously trained model
2) Freeze weights to avoid destroying any of the learned information
3) Add some new layers on top of the frozen layers
4) Train the new layers on your dataset

https://www.tensorflow.org/tutorials/images/transfer_learning
https://image-net.org

Hyperparameter Tuning / Optimization

KerasTuner comes with **Bayesian Optimization**, Hyperband [1], and Random Search algorithms built-in, and is also designed to be easy for researchers to extend in order to experiment with new search algorithm.

- **Hyperparameters** are used to specify a set of parameters and their values
- **Tuners** corresponding to different tuning algorithms are called directly to start the search or to get the best models
- **Oracles** are the core search algorithms, receiving model evaluation results from a tuner and providing new hyperparameter values



[1] LI, Lisha, et al. Hyperband: A novel bandit-based approach to hyperparameter optimization. *The Journal of Machine Learning Research*, 2017, 18. Jg., Nr. 1, S. 6765-6816.

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Thank you!