Machine Learning Knowledge Base

This section of the ML-INFN Confluence Space contains the Knowledge Base of fully implemented use cases. This has been created in order to provide new users getting close to Machine learning with concrete examples, with step by step guides for reproducibility.

The division into categories is multidimensional

- Dimension 1: per goal (classification, regression, clustering, technological ...)
- Dimension 2: per Machine Learning algorithms (CNN, Auto encoders, LSTM, GraphNet, ...)
- Dimension 3: per scientific field (High Energy Physics, Gravitational Waves, Medical Physics, ...)
- Dimension 4: per type of used tool

and is implemented via Confluence labels.

Table of Use cases

Name and Link	Goal	ML Algorithms	Scientific Field	ML Tools	Comments
Btagging in CMS (templated version)	Classification	CNN, LSTM	High Energy Physics	Keras + Tensorflow	Realistic application
LHCb Masterclass, with Keras	Density estimation and classification	MLP	High Energy Physics	ROOT + Keras + TF	Introductory tutorial
MNIST in a C header	Classification	MLP		Keras	Free-styling tutorial
LUMIN: Lumin Unifies Many Improvements for Networks	Technological	CNN, RNN, GNN	High Energy Physics	PyTorch	Package use examples
INFERNO: Inference-Aware Neural Optimisation	Classification	NN	High Energy Physics	Keras + Tensorflow	Technique application example
An introduction to classification with CMS data	Classification	Fisher, BDT, MLP	High Energy Physics	Scikit-learn, TF2	Tutorials for Master Students
Virgo Autoencoder tutorial	Data Compression	Autoencoder	General Relativity	Python Keras	Tutorial for student
Distributed training of neural networks with Apache Spark	Technological	DNN	High Energy Physics	Spark + BigDL	Tutorial
FTS log analysis with NLP	Self-supervised, clustering	NLP	High Energy Physics, Computing	Word2Vec + Rake + sklearn	Tutorial
Image Inpainting tutorial: how to digitally restore damaged images	Inpainting	CNN U-Net	Applied Physics	Keras + Sci-kit image, PIL, OpenCV, matplotlib	Tutorial
Signal/background discrimination for the VBF Higgs four lepton decay channel with the CMS experiment using Machine Learning classification techniques	Classification	ANNs, RF	High Energy Physics	Keras , TensorFlow, Scikit-learn	Tutorial
Explainability of a CNN classifier for breast density assessment	Explainability AI	CNN	Medical Physics	Keras, Tensorflow	Tutorial
ML for smart caching	Technological	ML/RL	High Energy Physics, Computing, Cache	Keras, Tensorflow, sklearn	Demo, playground
Signal-background Classification with Parametric Neural Networks	Classification	pNN	High Energy Physics	Keras + TensorFlow 2	Tutorial
New Physics Learning Machine	Density Estimation	NN	High Energy Physics	Keras, Tensorflow	package + tutorial
MLaaS4HEP for the Higgs boson ML challenge	Technological	DT, MLP	High Energy Physics	XGBoost, Keras + TensorFlow 2, PyTorch	Tutorial
Object counting with c-ResUnet	Supervised learning, Semantic Segmentation	CNN, ResUnet	Computer Vision	PyTorch, fastai	Real application, Tutorial
Fast classifier-based goodness of fit test for online data quality monitoring	Density estimation	Logistic Regression, Kernel Methods	High Energy Physics	Pytorch, Falkon library	Tutorial + Realistic application

How to insert a new use case

Follow the instructions provided in the How To: Create a KB entry

Once you finish with the creation of the page don't forget to edit the page "Machine Learning Knowledge Base" (this same page!) and add the use case in the "**Table of Use cases**".