

# Top 10 Machine Learning Optimizations Libraries

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# HyperOpt

- It is a technique to search by a hyperparameter space. It is a good way to meta-optimize a neural network. It can be very useful not only for tuning hyperparameters, but also to tune even more complex parameters, like changing the number of neurons in a layer.
- HyperOpt is typically aimed at very difficult search settings, especially ones with many hyperparameters and a small budget for function evaluations.
- This library provides algorithms and parallelization infrastructure for performing hyperparameter optimization.

Advantages	Disadvantages
1. It involves tuning of complex parameters very well.	1. There are no callbacks (used for long or distributed training) to monitor/snapshot/modify training after each iteration.
2. Saves and loads hyperparameter searches (time saving).	2. Visualization and documentation is not good.
3. speed and parallelization.	3. It cannot handle exceptions well.

## Optuna

- It is a Hyperparameter Optimization (HPO) framework, which is designed for machine learning. Main objective of Optuna is to make HPO more accessible as well as scalable. Some of its characteristics are:
  1. Parallel distributed optimization
  2. Lightweight, versatile, and platform agnostic architecture
  3. Pruning of unpromising trials
  4. Eager dynamic search spaces
  5. Integrations (XGBoost, Keras, Tensorflow, etc)

Advantages	Disadvantages
1. User callbacks are supported.	1. Absence of catalyst module which helps in easy integration without boilerplate.
2. It can handle exceptions very well.	
3. It is really good visualization and documentation.	
4. Saves and loads hyperparameter searches.	

## Tune

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- It is a python library used for fast hyperparameter tuning at any scale.
- Some of its characteristics are:
  1. It yields distributed asynchronous optimization.
  2. This hyperparameter search can be scaled from a single machine to a large distributed cluster without changing the code
- It supports machine learning frameworks like PyTorch, Keras, scikit-learn, XGBoost and MXNet.

Advantages	Disadvantages
1. It is scalable.	1. Potentially trapped at local optima.
2. It is flexible.	
3. Consists of fault tolerance which is not present in HyperOpt and Optuna.	

# Deap

DEAP is an advanced growing computation framework for faster prototyping and testing of ideas. It makes algorithms explicit and data structures transparent. It works in perfectly with parallelisation structure such as multiprocessing and SCOOP.

It consists of following characteristics:

- Genetic algorithm using any feasible representation
- Developmental approaches
- Multi-objective optimisation cooperative and competitive evolution of multiple populations
- Checkpoints that take snapshots of a system regularly
- Benchmarks module containing most common test functions

Advantages	Disadvantages
1. Regular monitoring via checkpoints.	1. It does not support graphical plotting of experimental results.
2. Approaches towards development are good.	2. The programming language itself has performance limitations.

# AutoML

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- Automated machine learning (AutoML) frameworks along with neural networks has resulted in the comeback of research on HPO.
- There has been recent interest emerged in complex and computationally expensive machine learning models with various hyperparameters. This hyperparameter tuning of machine learning models can be obtained using Bayesian optimization.
- AutoML's objective is to reduce the requirement for skilled data scientists to build machine learning and deep learning models. In fact, an AutoML system permits you to provide the labeled training data as input and receive an optimized model as output.

Advantages	Disadvantages
1. It reduces the manual work and makes everything automated.	1. Limited innovation, as one is bound to limited discovery.
2. It helps in implementation of complex machine learning models.	2. Constrained search spaces are required to be carefully composed.

# Test Tube

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Test tube is a library present in python, used to monitor and parallelize hyperparameter search for Deep Learning and Machine Learning experimentation. It's framework sceptic and also, is on the top of the python argparse API (Application Programming Interface) for ease of use. It permits you to easily monitor your machine learning experimentations.

## Uses of Test Tube:

- It can monitor various Experiments across models.
- Envision and compare different experiments without uploading anywhere.
- It can optimize hyperparameters with the use of grid or random search.
- Automatically track all the parameters.

Advantages
1. Monitors multiple experiments.
2. Easy to track parameters.



# SMAC3

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- SMAC is a device used to config algorithm in order to optimize the parameters of random algorithms. This also consists of hyperparameter optimization of Machine Learning techniques.
- It is not only bounded to optimization of parameters and hyperparameter optimization of many ML techniques. The core includes Bayesian Optimization with a simple racing mechanism on the instances to efficiently decide which of two configurations performs better.
- The main core consists of Bayesian Optimization in combination with a aggressive racing mechanism to efficiently decide which of two configuration performs better.

Advantages	Disadvantages
1. It is efficient to use and helps in deciding which configuration performed better.	1. As, SMAC uses random forest as a surrogate, the only drawback is that with increasing size of the forest, the computational complexity increases.

# H2O

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- H2O is a fully open source, distributed in-memory machine learning platform with linear scalability. It supports the most widely used statistical & machine learning algorithms including gradient boosted machines, generalized linear models, deep learning and more.
- H2O also has an industry leading AutoML functionality that automatically runs through all the algorithms and their hyperparameters to produce a leaderboard of the best models.

Advantages	Disadvantages
1. Simple Deployment.	1. It can't correctly read json sent over from python.
2. It uses leading algorithms.	
3. It is Distributed, in-memory processing (enables optimal efficiency without degradation in computational accuracy)	

# Talos

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- Talos changes Keras workflows without taking away any of Keras.
- It is made for data scientists and data engineers that want to stay in full control of their Keras models, but are tired of vacuous parameters and complex optimization outcomes that increases complexity instead of decreasing it. It allows you to configure, perform, and monitor hyperparameter optimization experiments that yield state-of-the-art results across a wide range of prediction tasks.
- Talos provides the simplest and yet most powerful technique for hyperparameter optimization with Keras.

Advantages	Disadvantages
1. It is easy to use.	1. It lacks support for multi-machine distribution of experiments.
2. It can work with any keras model and is faster to implement.	

# Advisor

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Advisor is the hyper parameters tuning system for black box optimization. Some of the supported algorithms are grid search, bayesian optimization, random search and so on.

It is an open-source implementation of Google Vizier with the following characteristics:

- Ease of use with API, SDK, WEB and CLI
- Consists of search and early stop algorithms
- Recommend parameters with trained model

Advantages	Disadvantages
1. It supports various algorithms such as grid and random search, early stop algorithms and so on.	1. It has no security configuration.
2. It is easy to use.	

# Thank You!

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**THANK YOU**