



PROJECT IMPLEMENTATION

HYPER-PARAMETER OPTIMIZATION
OF MACHINE LEARNING

Outline

- Introduction
- Hyperparameter Optimization motivation
- Hyper-parameters in Machine Learning Models
- Hyperparameter optimization Techniques
- Applying Optimization Techniques to Machine Learning Algorithms
- Implementation
- Conclusion



INTRODUCTION

What is the hyper-parameters?

What is hyper-parameter optimization?

Aim: To automate the hyper-parameters tuning process to get optimal model architecture of ML models



Hyper-parameter optimization motivation

In machine learning we distinguish:

Model parameters: can be initialized and updated in data learning process.

Model hyper-parameters: set by the user before training not changed during fitting data.

Parameters are learned by applying Gradient descent to optimization problem. But not for hyperparameters. **Why?**



Hyper-parameters in Machine Learning Models

Hyper-parameters in **supervised learning**

Hyper-parameters depends on the ML models.
SVM, KNN, CNN, Lasso and Ridge regression.



• Hyperparameter optimization Techniques

We need to use optimization techniques to get optimal hyper-parameters for the model.

There are many different methods:

- Babysitting
- **Grid search**
- Random forest
- Bayesian optimization
- Particle swarm optimization
- Genetic algorithm,...



- # Hyperparameter optimization Techniques

Grid Search

Grid search define a search space as grid of hyperparameters values and evaluate every position in the grid by finding the combinations.

For eg: 6 hyperparameters, each has 10 values, we must try 10^6 combinations

Take time!!!



Grid Search con't

Scikit-learn python source ML libraries provide technique to tune hyperparameters one is “GridSearchCV” which can be implemented to detect the optimal hyper-parameters using the GS algorithm

Calculate performance using cross validation.

the optimal hyper-parameter combination in the defined search space with its performance score will be returned.



- Applying Optimization Techniques to Machine Learning Algorithms

ML algorithms can be classified by the characteristics of their hyper-parameter configurations.

Appropriate optimization algorithms can be chosen to optimize the hyper-parameters based on these characteristics.



Implementation

- Data:
 - MNIST hand written digit recognition datasets
 - Boston housing datasets to predict house price.
- Tasks:
 - Classification problems
 - Regression problems
- HPO Algorithms to ML models:
 - Grid Search
 - Support Vector Machine



Conclusion

SVM: is not suitable for large datasets because of its high training time

