

Machine Learning and Deep Learning Optimizers Implementation

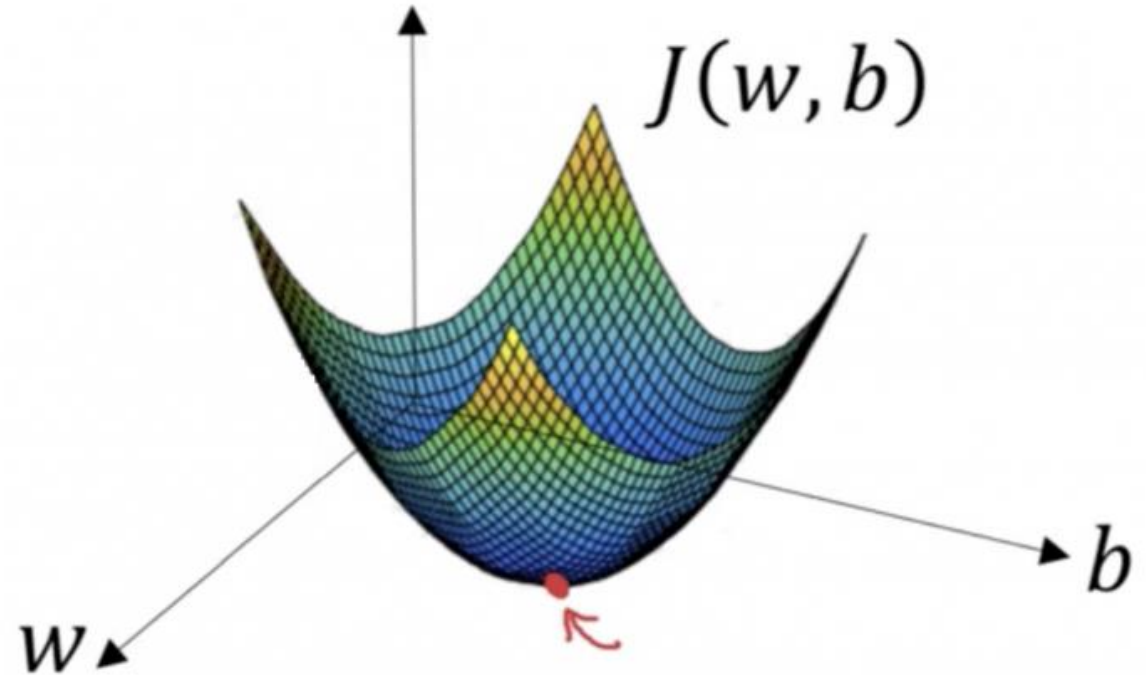
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ML&DL Optimizers

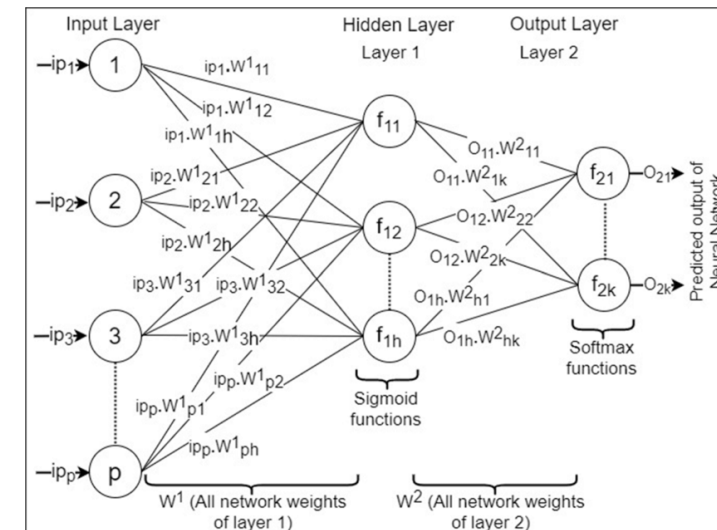
- In **ML&DL**, the **optimizers** are the **algorithms** used to find the best values of model parameters that minimize the model prediction error (**the minimum of loss function**).



ML&DL Optimizers

- **Optimizers** find the best model parameters of simple single variable and multivariable linear regression models as well as complex and deep learning models.

- **Single Variable LR:** $h_{\theta}(x) = \theta_0 + \theta_1 x$
- **Multi Variable LR** $h_{\theta}(x) = \theta_0 x_0 + \theta_1 x_1 + \theta_2 x_2 + \dots + \theta_n x_n$




ML&DL Optimizers

- Almost all ML&DL optimizers are **numerical optimization** algorithms such as:
 - Batch Gradient Descent (GD).
 - Stochastic GD (SGD).
 - Mini-Batch GD.
 - Momentum based GD.
 - Nesterov Accelerated Gradient (NAG).
 - Adagrad.
 - RMSProp.
 - Adam.
 - BFGS.

ML&DL Optimizers

- In order to use or even choose in the first place the suitable optimizer to train your model, adjusting hyperparameters, obtain fast and efficient training, and sometimes modify the optimization method, you must understand how the optimizer work.



ML&DL Optimizers

Fully understanding of ML&DL optimizers is crucial.

It is your first and most important step before learning ML&DL.

Master Numerical Optimization for ML&DL (NOFML&DL) in 5 Days

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You will learn almost all famous first order and second order optimization algorithms used in ML and DL such as:

- Batch Gradient Descent (GD).
- Mini-batch and Stochastic GD.
- Momentum.
- Nesterov Accelerated Gradient NAG.
- Adagrad.
- Rmsprop.
- Adam.
- Newton

Day_1 How to solve the ML problem using numerical optimization methods (e.g., Gradient Descent)
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Day_2_Part_1 Learning Rate, Convex vs. non-convex cost function
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Day_2_Part_2 Gradient Vector, Contour Plot, Gradient Descent Applied to Linear Regression
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Day_3_Part_1 Feature Scaling Effect on Training
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Day_3_Part_2 Stochastic and Mini Batch GD, Introduction to Momentum based GD
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Day_3_Part_3 Momentum based GD and Nesterov Accelerated Gradient NAG
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Day 4 Part 1 Adaptive Gradient Adagrad



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Why Shall We Study Numerical Optimization?

The Machine Learning Problem.

Analytical, Algebraic and Numerical Solutions.

Numerical Optimization.

Single Variable Linear Regression.

Vector Norms and Loss Function

Gradient

Gradient Descent (GD) Algorithm.



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Convex Function.

Gradient of Multivariable Function.

Contour Plot.

Local vs. Global Minimum.

GD Applied to LR (Single Variable).

GD Applied to Multivariable LR.

Features Scaling.



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Batch GD Problems.

GD Variants.

Stochastic GD.

Mini-Batch GD.

GD Challenges.



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Advanced Optimizers.

Momentum-based GD.


Nesterov accelerated GD (NAG).

Adaptive Learning Rate.

Adagrad.

RMSProp.

Adam.



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GD Connection to Taylor Series.

Second Order Optimization.

Newton's Method for Optimization.


Quasi-Newton Methods.

BFGS.

How to Understand the Optimizers?

- In order to understand the optimizers thoroughly, you need to implement it from scratch by yourself.
- See the effect of hyperparameters in training.
- Explore this effect by plotting the learning curves.






Machine Learning and Deep Learning Optimizers Implementation

PW 1: Implementation of Batch (Vanilla) GD for single variable LR model.

PW 2: Implementation of Batch (Vanilla) GD for Multi-variables LR model.

PW 3: Implementation of Stochastic GD for Single and Multi-variables LR model.


PW 4: Implementation of Mini-Batch GD for Single and Multi-variables LR model.



Machine Learning and Deep Learning Optimizers Implementation

PW 5: Implementation of Momentum based GD for Single and Multi-variables LR model.

PW 6: Implementation of NAG for Single and Multi-variables LR model.



Machine Learning and Deep Learning Optimizers Implementation

PW 7: Implementation of Adagrad for Single and Multi-variables LR model.

PW 8: Implementation of RMSProp for Single and Multi-variables LR model.

PW 9: Implementation of Adam for Single and Multi-variables LR model.

PW 10: Implementation of BFGS method for Single and Multi-variables LR model.



Resources

Master numerical optimization for ML&DL in 5 Days course material.

Data files.

Guided steps code files.

Ideal solution code files.

Attention

- You must do the implementation by yourself.
- Do not jump directly to the ideal solutions.



A high-angle, top-down view of a classroom. The floor is made of light-colored wooden planks. There are several black plastic chairs with attached wooden desks. The chairs are arranged in a somewhat circular pattern, with some facing towards the center and others facing outwards. The desks are a light brown color. The lighting is bright and even.

Enjoy the learning