Title: Deeplearning4j

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Categories: Category:Cluster computing, Category:Deep learning software, Category:Free data analysis software, Category:Free science software, Category:Free software programmed in Java (programming language), Category:Free software programmed in Scala, Category:Free statistical software, Category:Hadoop, Category:Image processing, Category:Java (programming language) libraries, Category:Java (programming language) software, Category:Java platform, Category:Java programming language family, Category:Natural language processing, Category:Numerical programming languages, Category:Open-source artificial intelligence, Category:Scala (programming language), Category:Software using the Apache license

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Supervised learning

Unsupervised learning

Semi-supervised learning

Self-supervised learning

Reinforcement learning

Meta-learning

Online learning

Batch learning

Curriculum learning

Rule-based learning

Neuro-symbolic AI

Neuromorphic engineering

Quantum machine learning

Classification

Generative modeling

Regression

Clustering

Dimensionality reduction

Density estimation

Anomaly detection

Data cleaning

AutoML

Association rules

Semantic analysis

Structured prediction

Feature engineering

Feature learning

Learning to rank

Grammar induction

Ontology learning

Multimodal learning

Apprenticeship learning

Decision trees

Ensembles Bagging Boosting Random forest

Bagging

Boosting

Random forest

k -NN

Linear regression

Naive Bayes

Artificial neural networks

Logistic regression

Perceptron

Relevance vector machine (RVM)

Support vector machine (SVM)

BIRCH

CURE

Hierarchical

k -means

Fuzzy

Expectation–maximization (EM)

DBSCAN

OPTICS

Mean shift

Factor analysis

CCA

ICA

LDA

NMF

PCA

PGD

t-SNE

SDL

Graphical models Bayes net Conditional random field Hidden Markov

Bayes net

Conditional random field

Hidden Markov

RANSAC

k -NN

Local outlier factor

Isolation forest

Autoencoder

Deep learning

Feedforward neural network

Recurrent neural network LSTM GRU ESN reservoir computing

LSTM

GRU

ESN

reservoir computing

Boltzmann machine Restricted

Restricted

GAN

Diffusion model

SOM

Convolutional neural network U-Net LeNet AlexNet DeepDream

U-Net

LeNet

AlexNet

DeepDream

Neural field Neural radiance field Physics-informed neural networks

Neural radiance field

Physics-informed neural networks

Transformer Vision

Vision

Mamba

Spiking neural network

Memtransistor

Electrochemical RAM (ECRAM)

Q-learning

Policy gradient

SARSA

Temporal difference (TD)

Multi-agent Self-play

Self-play

Active learning

Crowdsourcing

Human-in-the-loop

Mechanistic interpretability

RLHF

Coefficient of determination

Confusion matrix

Learning curve

ROC curve

Kernel machines

Bias–variance tradeoff

Computational learning theory

Empirical risk minimization

Occam learning

PAC learning

Statistical learning

VC theory

Topological deep learning

AAAI

ECML PKDD

NeurIPS

ICML

ICLR

IJCAI

ML

JMLR

Glossary of artificial intelligence

List of datasets for machine-learning research List of datasets in computer vision and image processing

List of datasets in computer vision and image processing

Outline of machine learning

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Eclipse Deeplearning4j is a programming library written in Java for the Java virtual machine (JVM). [2] [3] It is a framework with wide support for deep learning algorithms. [4] Deeplearning4j includes implementations of the restricted Boltzmann machine , deep belief net , deep autoencoder, stacked denoising autoencoder and recursive neural tensor network , word2vec , doc2vec, and

GloVe . These algorithms all include distributed parallel versions that integrate with Apache Hadoop and Spark . [5]

Deeplearning4j is open-source software released under Apache License 2.0 , [6] developed mainly by a machine learning group headquartered in San Francisco . [7] It is supported commercially by the startup Skymind, which bundles DL4J, TensorFlow , Keras and other deep learning libraries in an enterprise distribution called the Skymind Intelligence Layer. [8] Deeplearning4j was contributed to the Eclipse Foundation in October 2017. [9] [10]

Introduction

Deeplearning4j relies on the widely used programming language Java , though it is compatible with Clojure and includes a Scala application programming interface (API). It is powered by its own open-source numerical computing library, ND4J , and works with both central processing units (CPUs) and graphics processing units (GPUs). [11] [12]

Deeplearning4j has been used in several commercial and academic applications. The code is hosted on GitHub . [13] A support forum is maintained on Gitter . [14]

The framework is composable, meaning shallow neural nets such as restricted Boltzmann machines, convolutional nets, autoencoders, and recurrent nets can be added to one another to create deep nets of varying types. It also has extensive visualization tools, [15] and a computation graph. [16]

Distributed

Training with Deeplearning4j occurs in a cluster. Neural nets are trained in parallel via iterative reduce, which works on Hadoop -YARN and on Spark . [7] [17] Deeplearning4j also integrates with CUDA kernels to conduct pure GPU operations, and works with distributed GPUs.

Scientific computing for the JVM

Deeplearning4j includes an n-dimensional array class using ND4J that allows scientific computing in Java and Scala, similar to the functions that NumPy provides to Python . It's effectively based on a library for linear algebra and matrix manipulation in a production environment.

DataVec vectorization library for machine-learning

DataVec vectorizes various file formats and data types using an input/output format system similar to Hadoop's use of MapReduce; that is, it turns various data types into columns of scalars termed vectors . DataVec is designed to vectorize CSVs, images, sound, text, video, and time series. [18] [19]

Text and NLP

Deeplearning4j includes a vector space modeling and topic modeling toolkit, implemented in Java and integrating with parallel GPUs for performance. It is designed to handle large text sets.

Deeplearning4j includes implementations of term frequency–inverse document frequency (tf–idf), deep learning , and Mikolov's word2vec algorithm, [20] doc2vec, and GloVe, reimplemented and optimized in Java. It relies on t-distributed stochastic neighbor embedding (t-SNE) for word-cloud visualizations.

Real-world use cases and integrations

Real-world use cases for Deeplearning4j include network intrusion detection and cybersecurity, fraud detection for the financial sector, [21] [22] anomaly detection in industries such as manufacturing, recommender systems in e-commerce and advertising, [23] and image recognition. [24] Deeplearning4j has integrated with other machine-learning platforms such as RapidMiner, Prediction.io, [25] and Weka . [26]

Machine Learning Model Server

Deeplearning4j serves machine-learning models for inference in production using the free developer edition of SKIL, the Skymind Intelligence Layer. [27] [28] A model server serves the parametric machine-learning models that makes decisions about data. It is used for the inference

stage of a machine-learning workflow, after data pipelines and model training. A model server is the tool that allows data science research to be deployed in a real-world production environment.

What a Web server is to the Internet, a model server is to AI. Where a Web server receives an HTTP request and returns data about a Web site, a model server receives data, and returns a decision or prediction about that data: e.g. sent an image, a model server might return a label for that image, identifying faces or animals in photographs.

The SKIL model server is able to import models from Python frameworks such as Tensorflow, Keras, Theano and CNTK, overcoming a major barrier in deploying deep learning models.

Benchmarks

Deeplearning4j is as fast as Caffe for non-trivial image recognition tasks using multiple GPUs. [29] For programmers unfamiliar with HPC on the JVM, there are several parameters that must be adjusted to optimize neural network training time. These include setting the heap space, the garbage collection algorithm, employing off-heap memory and pre-saving data (pickling) for faster ETL. [30] Together, these optimizations can lead to a 10x acceleration in performance with Deeplearning4j.

API Languages: Java, Scala, Python, Clojure & Kotlin

Deeplearning4j can be used via multiple API languages including Java, Scala, Python, Clojure and Kotlin. Its Scala API is called ScalNet. [31] Keras serves as its Python API. [32] And its Clojure wrapper is known as DL4CLJ. [33] The core languages performing the large-scale mathematical operations necessary for deep learning are C, C++ and CUDA C.

Tensorflow, Keras & Deeplearning4j

Tensorflow, Keras and Deeplearning4j work together. Deeplearning4j can import models from Tensorflow and other Python frameworks if they have been created with Keras. [34]

See also

Free and open-source software portal

Computer programming portal

Comparison of deep learning software

Artificial intelligence

Machine learning

Deep learning

References

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Datasets

Digital geometry

Commercial systems

Feature detection

Geometry

Image sensor technology

Learning

Morphology

Motion analysis

Noise reduction techniques
Recognition and categorization
Research infrastructure
Researchers
Segmentation
Software
Computer stereo vision
Motion capture
Object recognition 3D object recognition
3D object recognition
3D reconstruction from multiple images
2D to 3D conversion
Gaussian splatting
Neural radiance field
Shape from focus
Simultaneous localization and mapping
Structure from motion
View synthesis
Visual hull
4D reconstruction Free viewpoint television Volumetric capture
Free viewpoint television
Volumetric capture
3D pose estimation
Activity recognition
Audio-visual speech recognition
Automatic image annotation
Automatic number-plate recognition
Automated species identification
Augmented reality
Bioimage informatics
Blob detection
Computer-aided diagnosis
Content-based image retrieval Reverse image search
Reverse image search
Eye tracking
Face recognition
Foreground detection
Gesture recognition

Image denoising

Image restoration

Landmark detection

Medical image computing

Object detection Moving object detection Small object detection

Moving object detection

Small object detection

Optical character recognition

Pose tracking

Remote sensing

Robotic mapping

Autonomous vehicles

Video content analysis

Video motion analysis

Video surveillance

Video tracking

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Comparison

Apache MXNet

Apache SINGA

Caffe

Deeplearning4j

DeepSpeed

Dlib

Keras

Microsoft Cognitive Toolkit

ML.NET

OpenNN

PyTorch

TensorFlow

Theano

Torch

ONNX

OpenVINO

MindSpore

Apple Core ML

IBM Watson

Neural Designer

Wolfram Mathematica

MATLAB Deep Learning Toolbox

Category