

Table 2. Classification of Deep Learning Libraries according to their features

Software Tool	Remarks
Theano	Used to evaluate mathematical expressing and able to handle numerical arrays.
Keras	It is a highly modular NN library, used for optimized tensor manipulation.
Lasagne	It is a lightweight library used to create and train NNs. It works on six principles: simplicity, transparency, modularity, pragmatism, restraint and focus.
Blocks	It is framework used to create NN models on top of Theano. Construct parameterized Theano operations (known as bricks). It annotates the Theano computational graph and maintains the flexibility effectively.
Caffe	It is mainly used in academic research projects and other industrial application. It is also applicable for large scale projects.
Cafee2	It is used to train large machine learning models. It helps in incorporating artificial intelligence in mobile applications [11].
nolearn	Unlike any other Deep Neural Network (DNN), nolearn is an abstraction layer on top of existing packages such as Theano and lasagna. It can work successfully without Graphics Processing Unit (GPU).
Gensim	Designed for large text collections, using data streaming and an efficient incremental learning. It supports various language processing algorithms.
Chainer	A 2 nd generation DL framework. Chainer implements CuPy that allows GPU for faster computation. It is partially compatible with NumPy that effectively supports existing multi-dimensional array library.
CXXNET	It is developed on MShadow (a Lightweight CPU (or GPU) Tensorflow library) that helps in writing expression for ML.
DeepPy	It is developed on top of NumPy with GPU acceleration. It fills the gap between high performance NNs and ease of development using Python or NumPy [12].
Neon	Neon has syntax similar to Theano/Keras. It has feature of Machine Learning Operations (MOP) Layer that enables other frameworks to use Neon. It has been ranked as the fastest framework over various benchmarks.
H2O	It is fast, memory efficient, based on columnar compression and fine grain MapReduce. It reduces the run time and model tuning through model checkpointing.
TensorFlow	Both TensorFlow and Theano provide very similar systems. But, TensorFlow has better support for distributed systems. TensorFlow programs are generally structured in to a construction phase that assembles a computation graph.
MXNet	It provides interface to build various types (Feedforward, Recurrent and Convolution) neural network. It works on three main concepts: NDAarray (offers matrix and tensor computation), Symbol (used to define neural network) and KVStore (used to achieve data synchronization among GPUs).
ConvNet	It is MATLAB based convolution neural network toolbox for classification and segmentation, can be trained on both CPU and GPU.
DeepLearnToolBox	It is open source MATLAB toolbox for deep learning. It is easy to use, but slow (only CPU version is available).
cuda-convnet	It provides an efficient implementation of convolution neural network in CUDA. It avoids use of temporary memory and it has ability to optimize multiple objectives simultaneously.
MatConvNet	It implements convolution neural networks for MATLAB. It is popular in due to its deep integration with MATLAB environment. Unlike Deep Learn Toolbox, MatConvNet support both CPU and GPU.
EBlearn	It describes both supervised and unsupervised training methods for probabilistic and non-probabilistic factor graph. It is composed of two key components: <i>libidx</i> and <i>libelearn</i> .
SINGA	It provides flexible architecture for distributed training and used in health-care applications.
NVIDIA DIGITS	It is not a framework but it provides a graphical web interface to other frameworks such as Tensorflow, Torch, Caffe etc.
ND4J	It is a distributed deep learning library, can be implemented on CPUs and GPUs and it provides Java and Scala APIs.
Deeplearning4J	It is domain specific library to configure deep learning networks. Hyperparameters are used to determining how neural networks learn.
Encog	It is a framework that provides a GUI based workbench to train machine learning algorithm.
Convnet.js	JavaScript deep learning models for neural network, which entirely based on browser.
Torch	Fast computing framework based on Lua-JIT with strong CPU, CUDA and Tensor library. It can support multi-GPU and parallelization.
Mocha	It is JavaScript unittest framework that runs on Node.js and in the browser.
Lush	It provide huge library for numerical, image, graphics and signal processing routines.
DNNGraph	It is a DSL model generation in Haskell that uses lens and fgl graph library to specify network layout.
Accord.NET	It is a framework in .NET, divided into libraries, used for wide range of scientific computing.
darch	It provides native implementation of deep neural network with learning algorithms in R. It consists of three classes: Net (represents an abstract class), RBM (Restricted Boltzmann Machine) - used in pre-training and DArch (represents deep neural networks for pre-training and fine tuning).
deepnet	It has 3×3 architecture for deep learning. It is relatively smaller than darch.