TensorFlow (1)

고려대학교 INI Lab

Contents

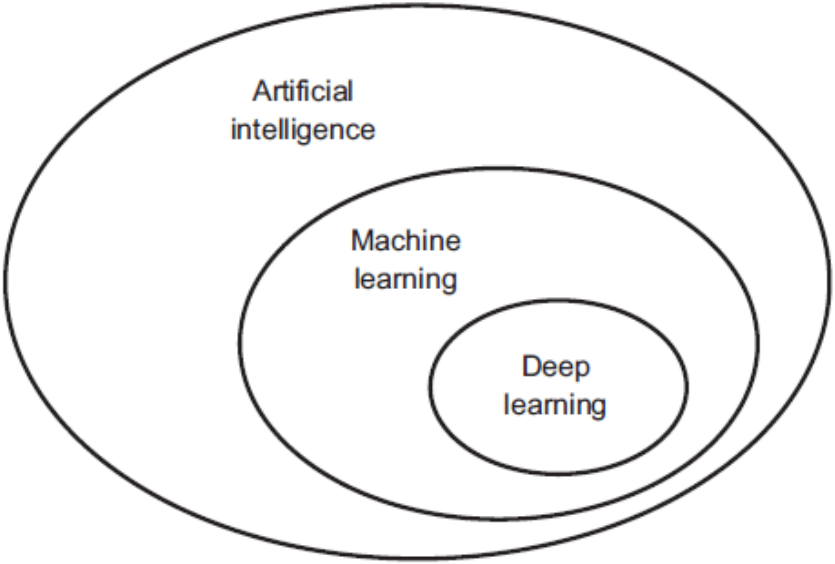
copyright© 2018 All rights reserved by Korea University

Deep Learning

Deep Learning?

copyright© 2018 All rights reserved by Korea University

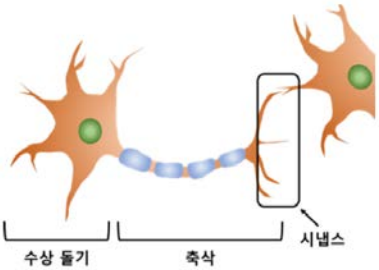
Deep Learning?

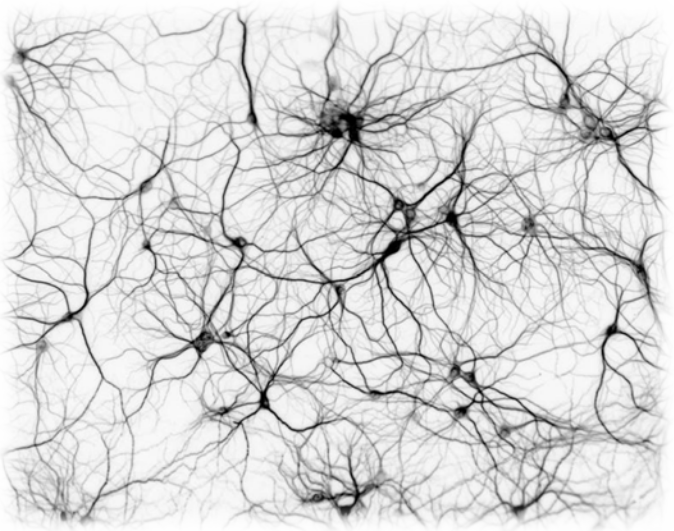


copyright© 2018 All rights reserved by Korea University

Neural Network

신경 세포와 뇌가 지식을 추론하고 학습하는 구조를 추상화한 모델

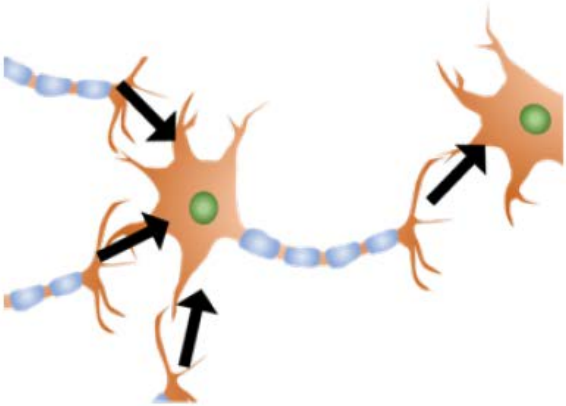




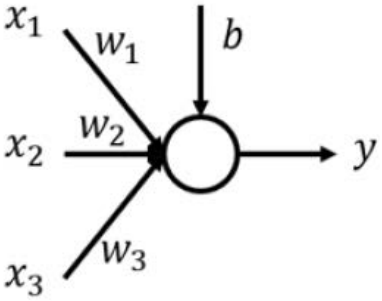
copyright© 2018 All rights reserved by Korea University

Neural Network

신경 세포와 뇌가 지식을 추론하고 학습하는 구조를 추상화한 모델



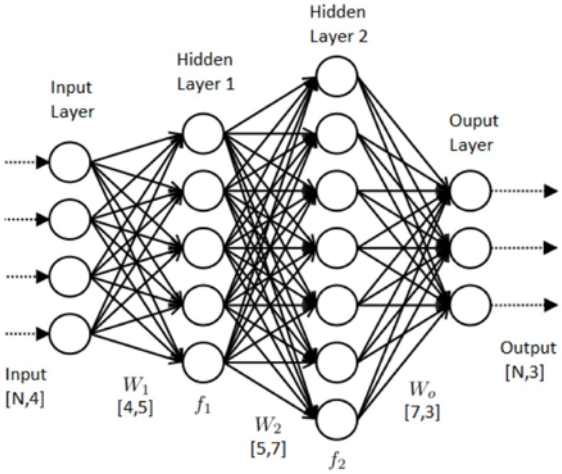
Neuron

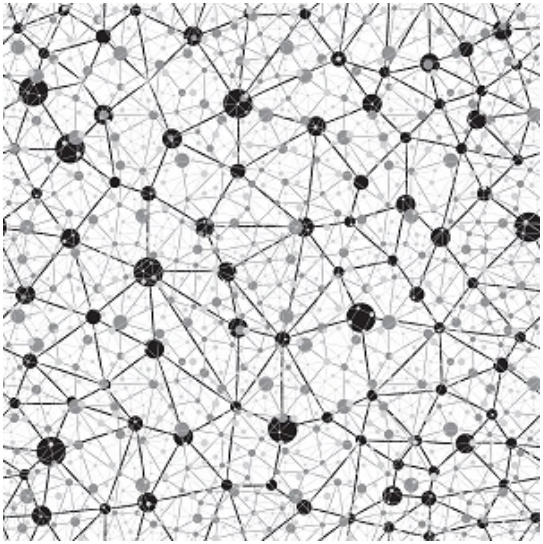


Perceptron

copyright© 2018 All rights reserved by Korea University

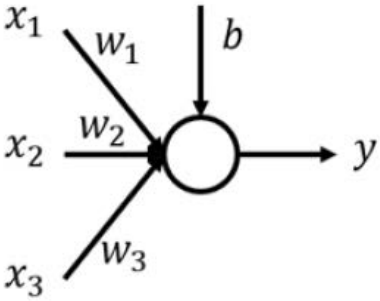
Neural Network ≠ Brain



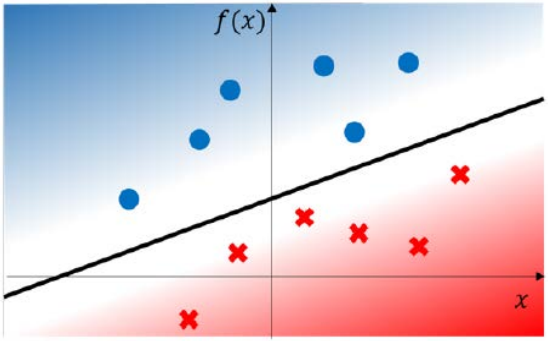


copyright© 2018 All rights reserved by Korea University

Perceptron

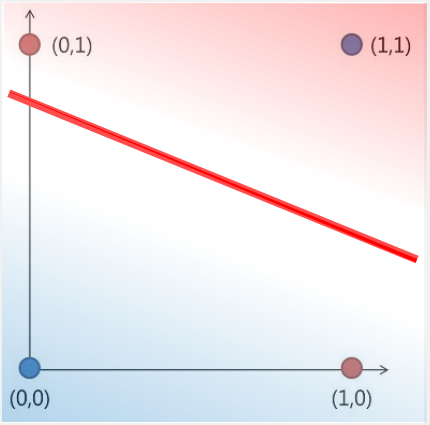


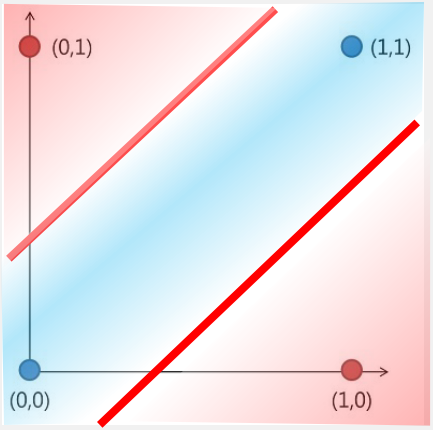
Perceptron



Linear Classification

copyright© 2018 All rights reserved by Korea University



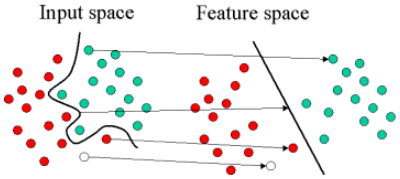


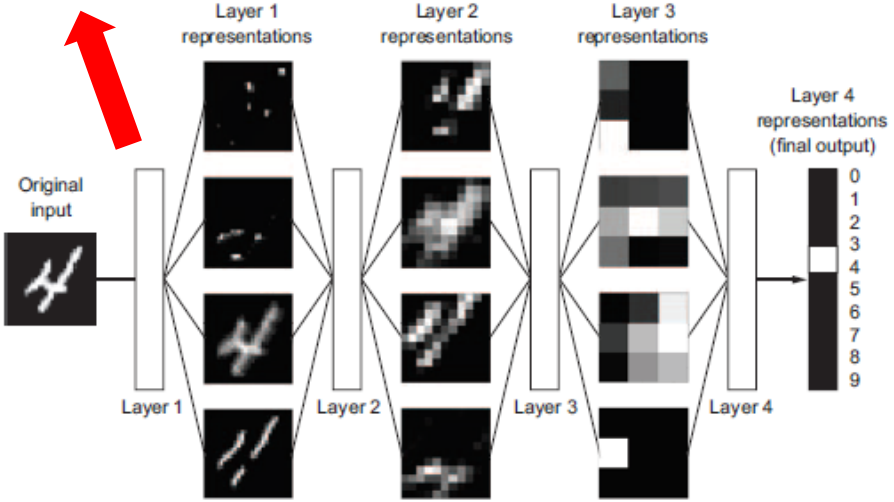
Why Deep?

단일 Linear Classification으로는 해결할 수 없는 문제가 존재

▶ 여러 개의 Linear Classification을 적용해서 문제를 해결

Why Deep?





Low Level → High Level

copyright© 2018 All rights reserved by Korea University

Why Deep Learning Again?

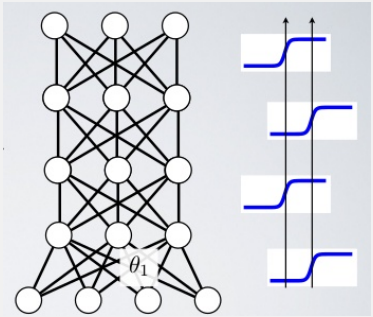
본래 SVM 등의 다른 기계학습 기법에 밀려 사용되지 않았으나, 최근 들어 다시 각광받고 있음

하드웨어의 발전

다른 기계 학습에 비해 느린 학습 속도
- 발전된 하드웨어 성능
- GPU를 이용한 학습

빅 데이터

데이터의 개수가 적을 경우 일반화를 잘 하지 못함
- Web2.0으로 등장한 빅 데이터로 해결



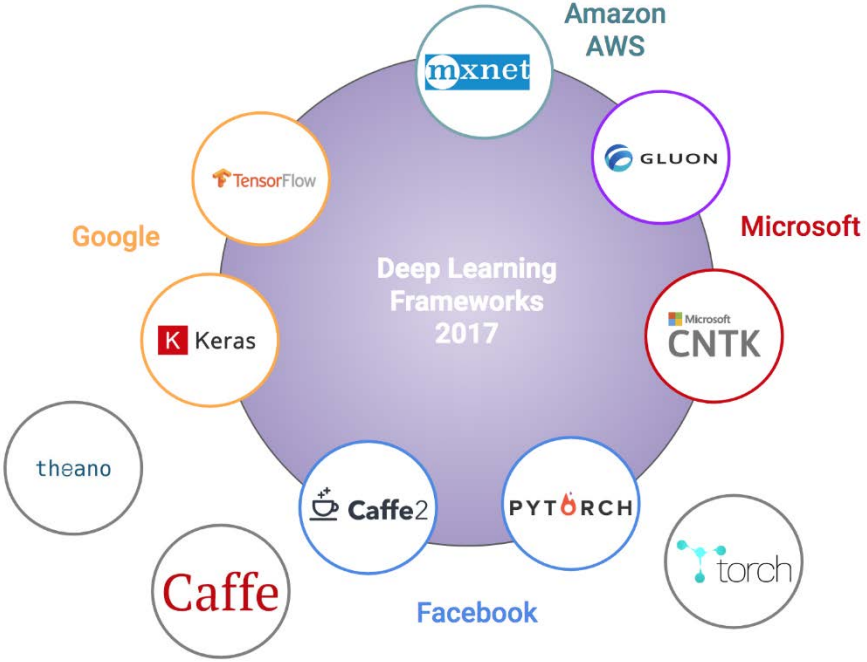
기존 문제 해결

Gradient Vanishment
과적합(Overfitting) 등
- 새로운 기법 개발

copyright© 2018 All rights reserved by Korea University

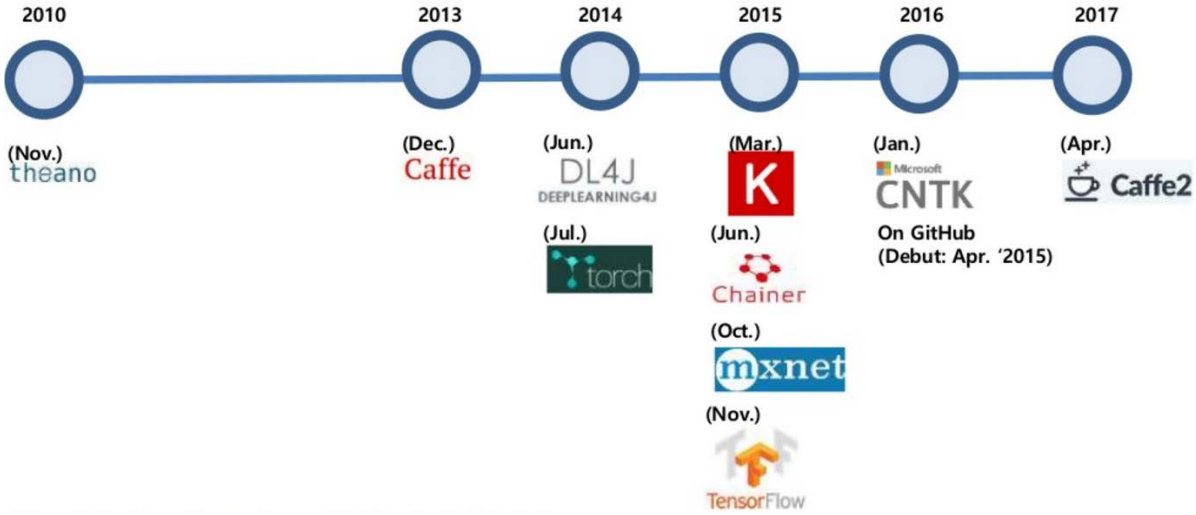
Deep Learning Framework

Deep Learning Framework



copyright© 2018 All rights reserved by Korea University

History of Deep Learning Framework



출처 : https://www.popit.kr/딥러닝-프레임워크-조사와-몇가지-홍보

copyright© 2018 All rights reserved by Korea University

Deep Learning Framework Comparison

F/W	주체	플랫폼	모바일	언어	인터페이스	OpenMP	CUDA	OpenCL	멀티GPU	분산
Caffe	BAIR	Linux, Mac	-	C++	Python, MATAB	Y	Y	-	Y	
Chainer	Preferred Networks	Linux	-	Python	Python	-	Y	-	Y	Y
CNTK	Microsoft	Linux, Windows	-	C++	Python, C++	Y	Y	-	Y	Y
DL4J	SkyMind	Cross-platform (JVM)	Android	Java	Java, Scala, Python	Y	Y	-	Y	Y (Spark)
Keras	François Chollet	Linux, Mac, Windows	-	Python	Python	Y(Theano) N(TF)	Y	-	Y	
MXNet	DMLC	Linux, Mac, Windows, Javascript	Android, iOS	C++	C++, Python, Julia, MATLAB, JavaScript, Go, R, Scala, Perl	Y	Y	-	Y	Y
TensorFlow	Google	Linux, Mac, Windows	Android, iOS	C++, Python	Python, C/C++, Java, Go	N	Y	-	Y	Y
Theano	Université de Montréal	Linux, Mac, Windows	-	Python	Python	Y	Y	-	Y	
Torch	Ronan, Clément, Koray, Soumith	Linux, Mac, Windows	Android, iOS	C, Lua	Lua	Y	Y	Y	Y	Not officially

출처 : https://www.popit.kr/딥러닝-프레임워크-조사와-몇가지-홍보

copyright© 2018 All rights reserved by Korea University

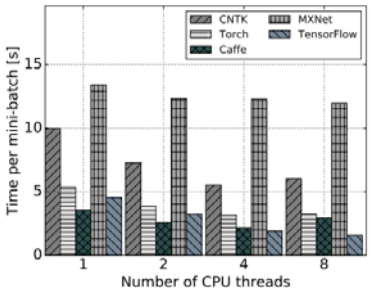
Deep Learning Framework Comparison

Design Choice	Torch.nn	Theano	Caffe	Chainer	MXNet	Tensor-Flow	PyTorch
NN definition	Script (Lua)	Script* (Python)	Data (protobuf)	Script (Python)	Script (many)	Script (Python)	Script (Python)
Backprop	Through graph	Extended graph	Through graph	Through graph	Extended graph	Extended graph	Through graph
Parameters	Hidden in operators	Separate nodes	Hidden in operators	Separate nodes	Separate nodes	Separate nodes	Separate nodes
Update formula	Outside of graphs	Part of graphs	Outside of graphs	Outside of graphs	Outside of graphs	Part of graphs	Outside of graphs
Graph construction	Static	Static	Static	Dynamic	Static	Static	Dynamic
Graph Optimization	-	Supported	-	-	-	Supported	-
Parallel computation	Multi GPU*	Multi GPU	Multi GPU*	Multi GPU**	Multi node Multi GPU	Multi node Multi GPU	Multi GPU**

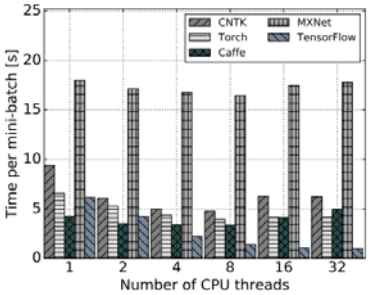
출처 : DLIF: Differences of deep learning frameworks

copyright© 2018 All rights reserved by Korea University

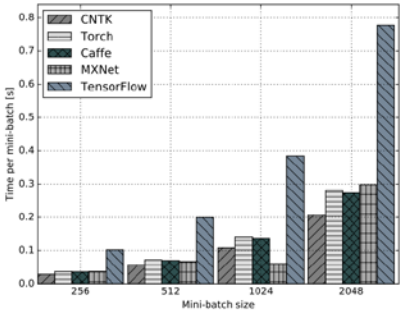
Deep Learning Framework Comparison



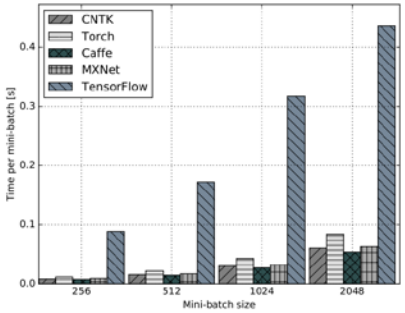
(a) Results on i7-3820.



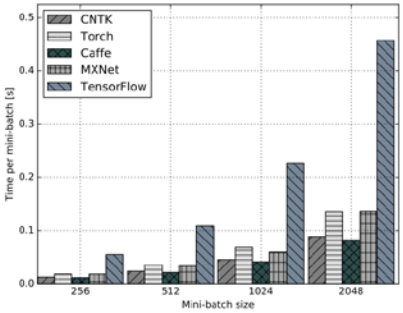
(b) Results on E5-2630.



(a) Results on Tesla K80.



(b) Results on GTX1080.



(c) Results on GTX980.

출처 : Benchmarking State-of-the-Art Deep Learning Software Tools

copyright© 2018 All rights reserved by Korea University

Which Framework to Choose?

1. You are a PhD student on DL itself: **TensorFlow, Theano, Torch**

2. You want to use DL only to get features: **Keras, Caffe**

3. You work in industry: **TensorFlow, Caffe**

4. You started your 2 month internship: **Keras, Caffe**

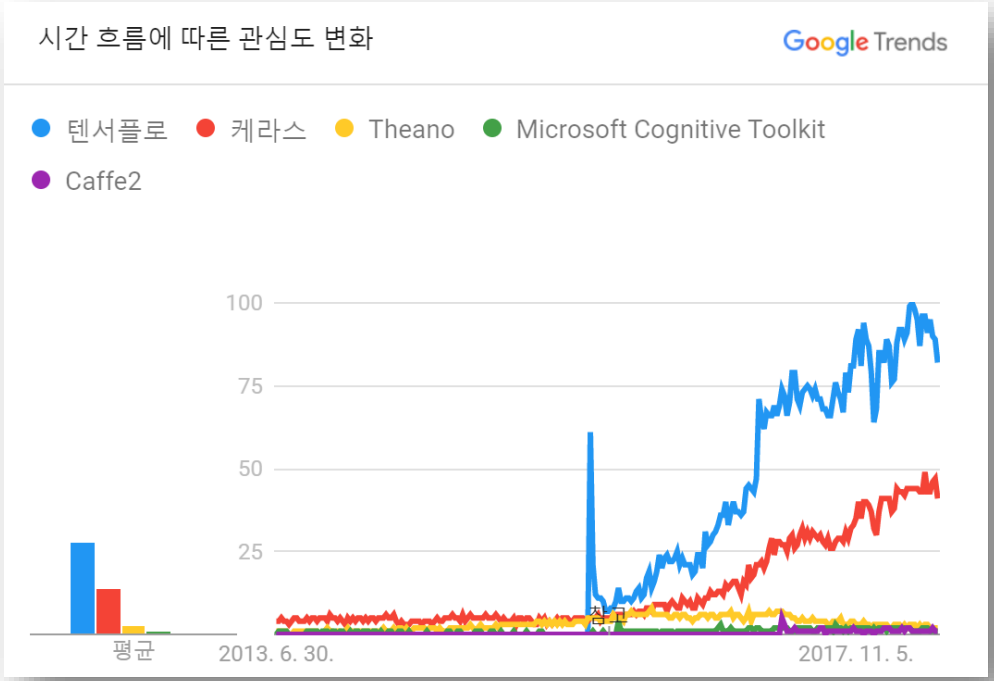
5. You want to give practice works to your students: **Keras, Caffe**

6. You are curious about deep learning: **Caffe**

7. You don't even know python: **Keras, Torch**

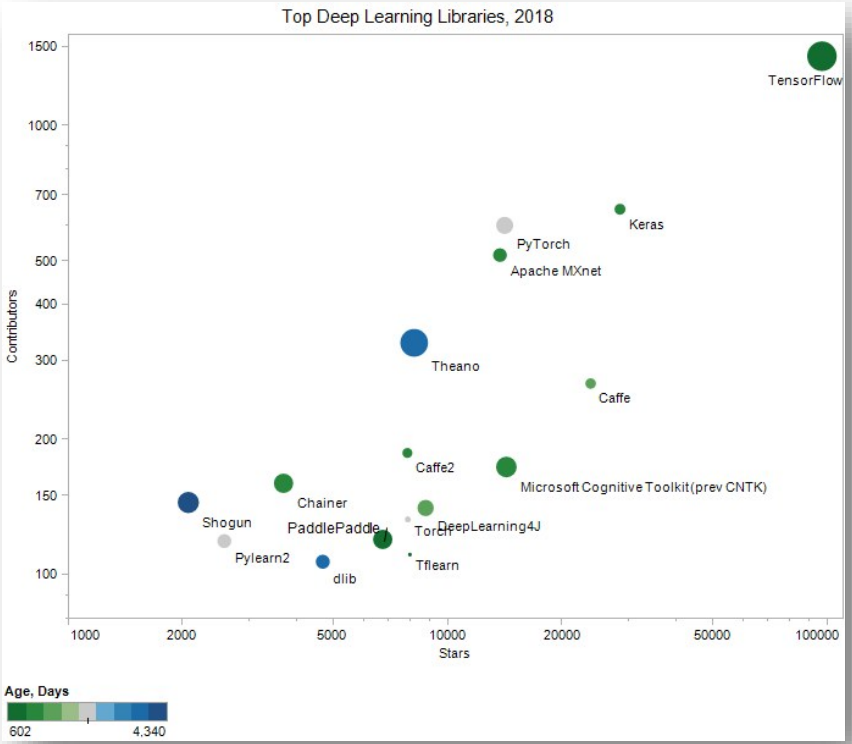
copyright© 2018 All rights reserved by Korea University

Why TensorFlow?



copyright© 2018 All rights reserved by Korea University

Why TensorFlow?



copyright© 2018 All rights reserved by Korea University

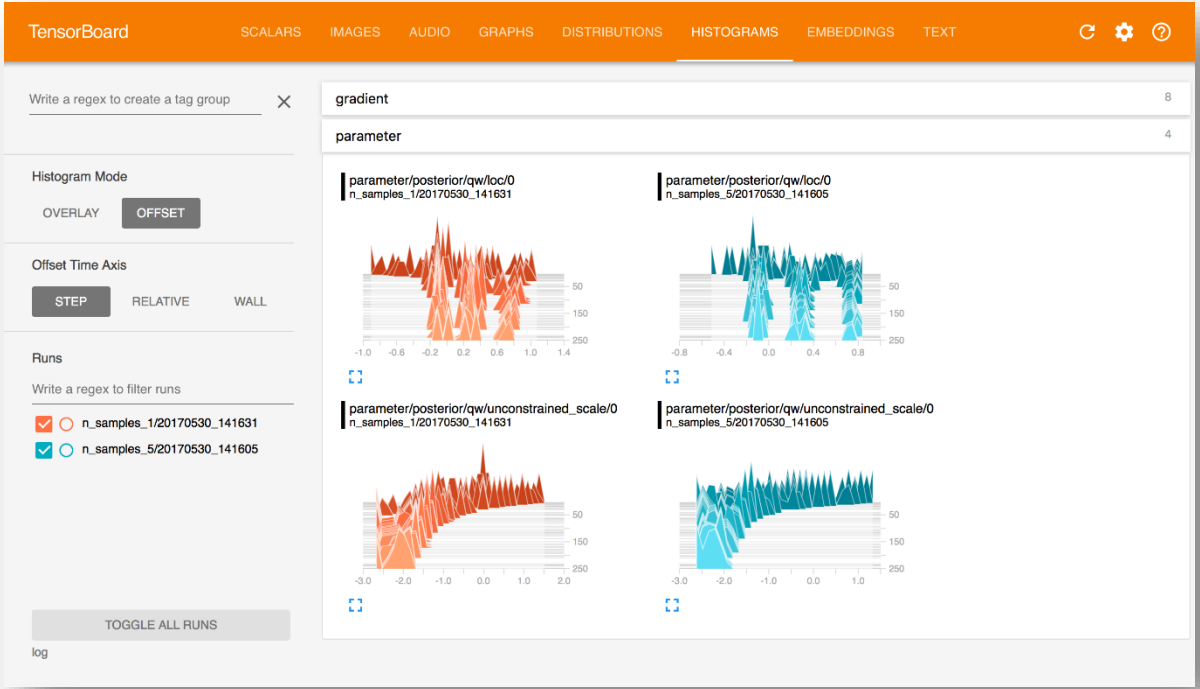
Why TensorFlow?

Library	Rank	Overall	Github	Stack Overflow	Google Results
tensorflow	1	10.87	4.25	4.37	2.24
keras	2	1.93	0.61	0.83	0.48
caffe	3	1.86	1.00	0.30	0.55
theano	4	0.76	-0.16	0.36	0.55
pytorch	5	0.48	-0.20	-0.30	0.98
sonnet	6	0.43	-0.33	-0.36	1.12
mxnet	7	0.10	0.12	-0.31	0.28
torch	8	0.01	-0.15	-0.01	0.17
cntk	9	-0.02	0.10	-0.28	0.17
dlib	10	-0.60	-0.40	-0.22	0.02
caffe2	11	-0.67	-0.27	-0.36	-0.04
chainer	12	-0.70	-0.40	-0.23	-0.07
paddlepaddle	13	-0.83	-0.27	-0.37	-0.20
deeplearning4j	14	-0.89	-0.06	-0.32	-0.51
lasagne	15	-1.11	-0.38	-0.29	-0.44
bigdl	16	-1.13	-0.46	-0.37	-0.30
dynet	17	-1.25	-0.47	-0.37	-0.42
apache singa	18	-1.34	-0.50	-0.37	-0.47
nvidia digits	19	-1.39	-0.41	-0.35	-0.64
matconvnet	20	-1.41	-0.49	-0.35	-0.58
tflearn	21	-1.45	-0.23	-0.28	-0.94
nervana neon	22	-1.65	-0.39	-0.37	-0.89
opennn	23	-1.97	-0.53	-0.37	-1.07

많은 사람들이 쓴다!

- ▶ 새로운 기능이 빠르게 추가
- ▶ 이미 만들어놓은 모델이 많음
- ▶ 문제가 생길 경우 해법을 찾기 쉬움

Why TensorFlow?



copyright© 2018 All rights reserved by Korea University

TensorFlow Introduction

TensorFlow?

copyright© 2018 All rights reserved by Korea University

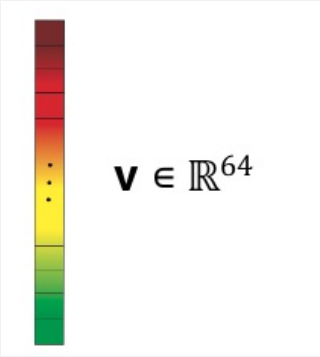
TensorFlow?

Tensor + Flow

copyright© 2018 All rights reserved by Korea University

Tensor

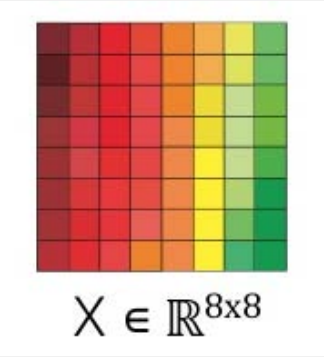
TensorFlow 등의 Deep Learning Framework에서 사용하는 데이터의 기본 단위



Vector

/

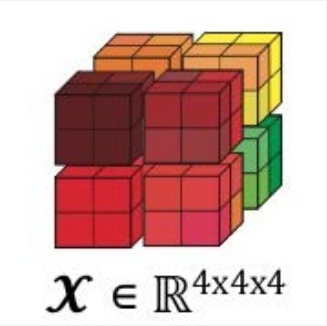
1-D Array



Matrix

/

2-D Array



Tensor

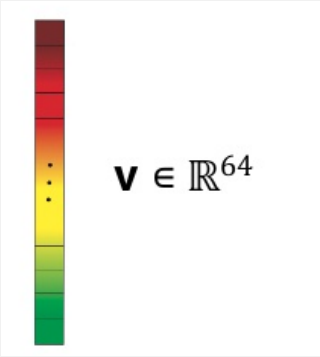
/

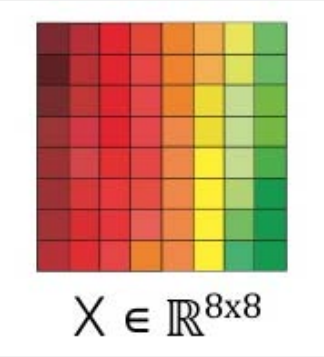
3-D Array

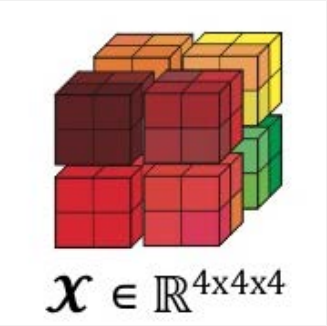
copyright© 2018 All rights reserved by Korea University

Tensor

TensorFlow 등의 Deep Learning Framework에서 사용하는 데이터의 기본 단위







Vector	Matrix	Tensor
1-D Array		N-D Array
1-D Tensor	2-D Tensor	N-D Tensor

copyright© 2018 All rights reserved by Korea University

Array vs Tensor

Iris.csv (4.99 KB)

	Id Unique ID	SepalLengthCm Length of the sepal (in cm)	SepalWidthCm Width of the sepal (in cm)	PetalLengthCm Length of the petal (in cm)	PetalWidthCm Width of the petal (in cm)	Species Species name
	1.00 150	4.30 7.90	2.00 4.40	1.00 6.90	0.10 2.50	Iris-setosa 33% Iris-versicolor 33% Other (1) 33%
1	1	5.1	3.5	1.4	0.2	Iris-setosa
2	2	4.9	3.0	1.4	0.2	Iris-setosa
3	3	4.7	3.2	1.3	0.2	Iris-setosa
4	4	4.6	3.1	1.5	0.2	Iris-setosa
5	5	5.0	3.6	1.4	0.2	Iris-setosa
6	6	5.4	3.9	1.7	0.4	Iris-setosa
7	7	4.6	3.4	1.4	0.3	Iris-setosa
8	8	5.0	3.4	1.5	0.2	Iris-setosa
9	9	4.4	2.9	1.4	0.2	Iris-setosa
10	10	4.9	3.1	1.5	0.1	Iris-setosa

Array ( ) Tensor ( )

copyright© 2018 All rights reserved by Korea University

Array vs Tensor

Iris.csv (4.99 KB)

	Id Unique ID	SepalLengthCm Length of the sepal (in cm)	SepalWidthCm Width of the sepal (in cm)	PetalLengthCm Length of the petal (in cm)	PetalWidthCm Width of the petal (in cm)	Species Species name
	1.00 – 150	4.30 – 7.90	2.00 – 4.40	1.00 – 6.90	0.10 – 2.50	Iris-setosa 33% Iris-versicolor 33% Other (1) 33%
1	1	5.1	3.5	1.4	0.2	Iris-setosa
2	2	4.9	3.0	1.4	0.2	Iris-setosa
3	3	4.7	3.2	1.3	0.2	Iris-setosa
4	4	4.6	3.1	1.5	0.2	Iris-setosa
5	5	5.0	3.6	1.4	0.2	Iris-setosa
6	6	5.4	3.9	1.7	0.4	Iris-setosa
7	7	4.6	3.4	1.4	0.3	Iris-setosa
8	8	5.0	3.4	1.5	0.2	Iris-setosa
9	9	4.4	2.9	1.4	0.2	Iris-setosa
10	10	4.9	3.1	1.5	0.1	Iris-setosa

Array (O) Tensor (O)

copyright© 2018 All rights reserved by Korea University

Array vs Tensor

heroes_information.csv (48.04 KB)

	# Row Identification	name The name or aka of super hero	Gender Gender of the Super Hero	Eye color Color of the eye.	Race	Hair color
	0.00 – 733	Goliath 0% Spider-Man 0% Other (713) 99%	Male 69% Female 27% Other (1) 4%	blue 31% - 23% Other (21) 46%	- 41% Human 28% Other (60) 30%	- 23% Black 22% Other (28) 55%
1	0	A-Bomb	Male	yellow	Human	No Hair
2	1	Abe Sapien	Male	blue	Icthyo Sapien	No Hair
3	2	Abin Sur	Male	blue	Ungaran	No Hair
4	3	Abomination	Male	green	Human / Radiation	No Hair
5	4	Abraxas	Male	blue	Cosmic Entity	Black
6	5	Absorbing Man	Male	blue	Human	No Hair
7	6	Adam Monroe	Male	blue	-	Blond
8	7	Adam Strange	Male	blue	Human	Blond
9	8	Agent 13	Female	blue	-	Blond
10	9	Agent Bob	Male	brown	Human	Brown

Array ( ) Tensor ( )

copyright© 2018 All rights reserved by Korea University

Array vs Tensor

heroes_information.csv (48.04 KB)

	# Row Identification	A name The name or aka of super hero	A Gender Gender of the Super Hero	A Eye color Color of the eye.	A Race	A Hair color
	0.00 – 733	Goliath 0% Spider-Man 0% Other (713) 99%	Male 69% Female 27% Other (1) 4%	blue 31% - 23% Other (21) 46%	- 41% Human 28% Other (60) 30%	- 23% Black 22% Other (28) 55%
1	0	A-Bomb	Male	yellow	Human	No Hair
2	1	Abe Sapien	Male	blue	Icthyo Sapien	No Hair
3	2	Abin Sur	Male	blue	Ungaran	No Hair
4	3	Abomination	Male	green	Human / Radiation	No Hair
5	4	Abraxas	Male	blue	Cosmic Entity	Black
6	5	Absorbing Man	Male	blue	Human	No Hair
7	6	Adam Monroe	Male	blue	-	Blond
8	7	Adam Strange	Male	blue	Human	Blond
9	8	Agent 13	Female	blue	-	Blond
10	9	Agent Bob	Male	brown	Human	Brown

Array (O) Tensor (X)

copyright© 2018 All rights reserved by Korea University

Data Must be Represented in Vector Space

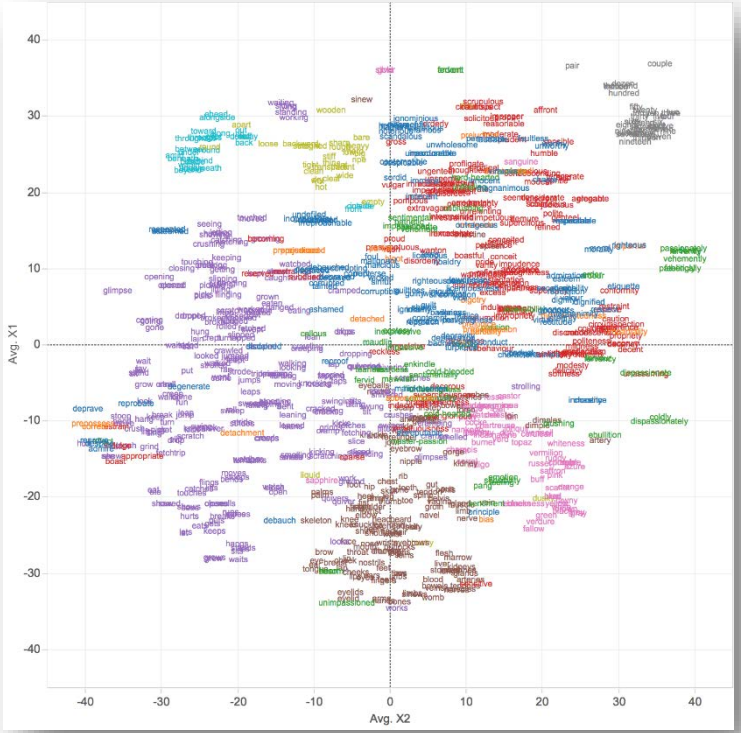
One-hot Encoding

Religion	Catholic	Protestant	Jewish	Muslim
Catholic	1	0	0	0
Muslim	0	0	0	1
Jewish	0	0	1	0
Protestant	0	1	0	0
Catholic	1	0	0	0
Catholic	1	0	0	0
Jewish	0	0	1	0
Protestant	0	1	0	0
Muslim	0	0	0	1
Protestant	0	1	0	0

copyright© 2018 All rights reserved by Korea University

Data Must be Represented in Vector Space

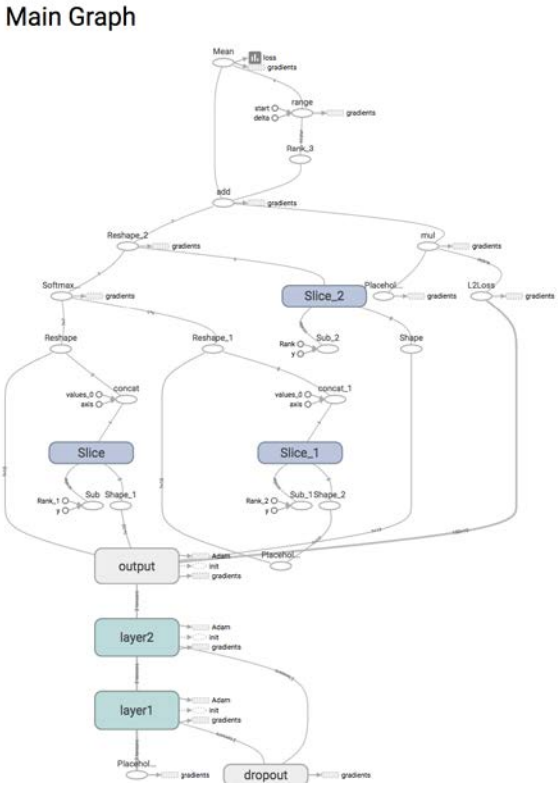
Data Embedding



copyright© 2018 All rights reserved by Korea University

Flow

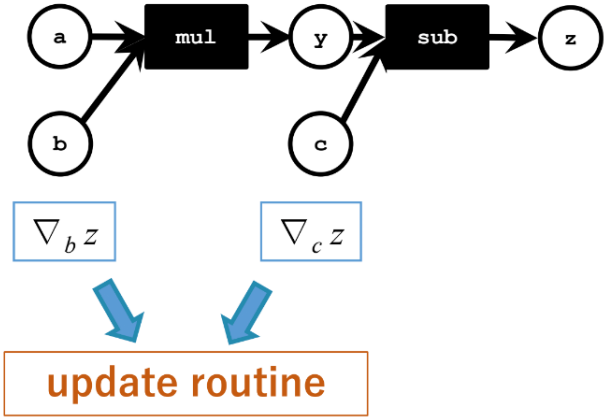
Tensor의 계산은 graph의 flow 형태로 표현

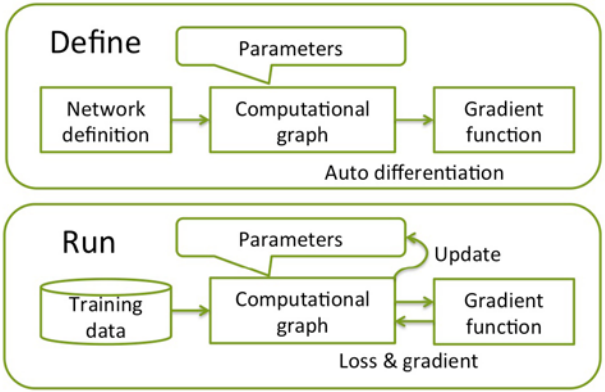


copyright© 2018 All rights reserved by Korea University

Symbol-to-Symbol Approach

모델 그래프를 먼저 구성한 후, 데이터를 넣어서 모델 학습



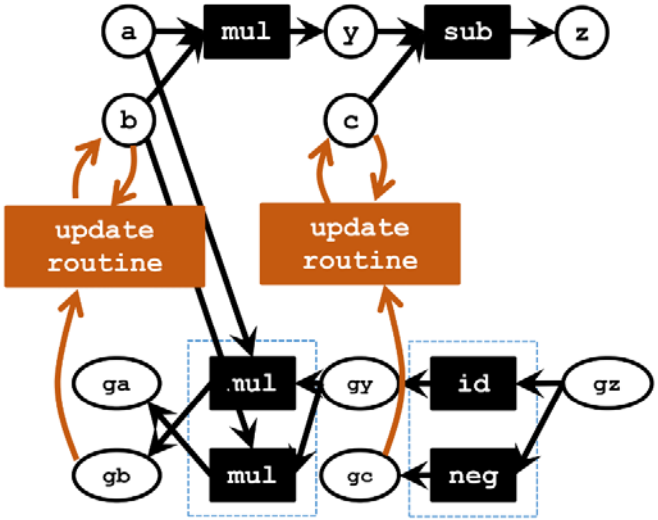


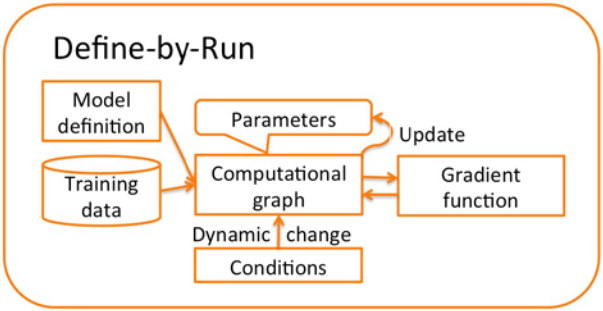
출처 : DLIF: Differences of deep learning frameworks,
Complex neural networks made easy by Chainer

copyright© 2018 All rights reserved by Korea University

Symbol-to-Value Approach

데이터를 이용하여 모델을 학습하는 과정에서, 동시에 모델 그래프를 생성





출처 : DLIF: Differences of deep learning frameworks,
Complex neural networks made easy by Chainer

copyright© 2018 All rights reserved by Korea University