



จุฬาลงกรณ์มหาวิทยาลัย  
Chulalongkorn University  
Pillar of the Kingdom



**2301648 Architecture of  
Deep learning**



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# Outline

1. Big data
2. AI-ML-DL
3. History of DL
4. DL model
5. Topics



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# Big Data 4V

**90%**  
of today's  
data  
has been created  
in just the last  
2 years



Every day  
we create  
**2.5**  
quintillion  
bytes of data



(...enough to fill  
**10 million**  
Blu-ray  
discs)



**Volume**  
Scale of data



**50,000**  
GB/second  
is the estimated  
rate of global  
Internet  
traffic  
by 2018



Every  
**60**  
seconds  
there are

**72 hours**  
of footage  
uploaded to  
YouTube



**216,000**  
Instagram posts



**204,000,000**  
emails sent



**Velocity**  
Speed of data



**1 in 3**  
business leaders  
don't trust the  
information they use  
to make decisions

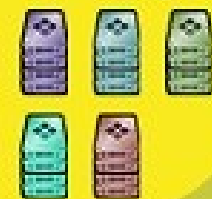


**\$3.1** trillion  
is the estimated  
amount of money that  
poor data quality costs  
the US economy per year

**Veracity**  
Certainty of data



**Variety**  
Diversity of data



**80%** of data  
growth is video,  
images and  
documents



**90%**  
of generated data  
is "unstructured"  
This includes tweets, photos,  
customer purchase histories  
and customer service calls

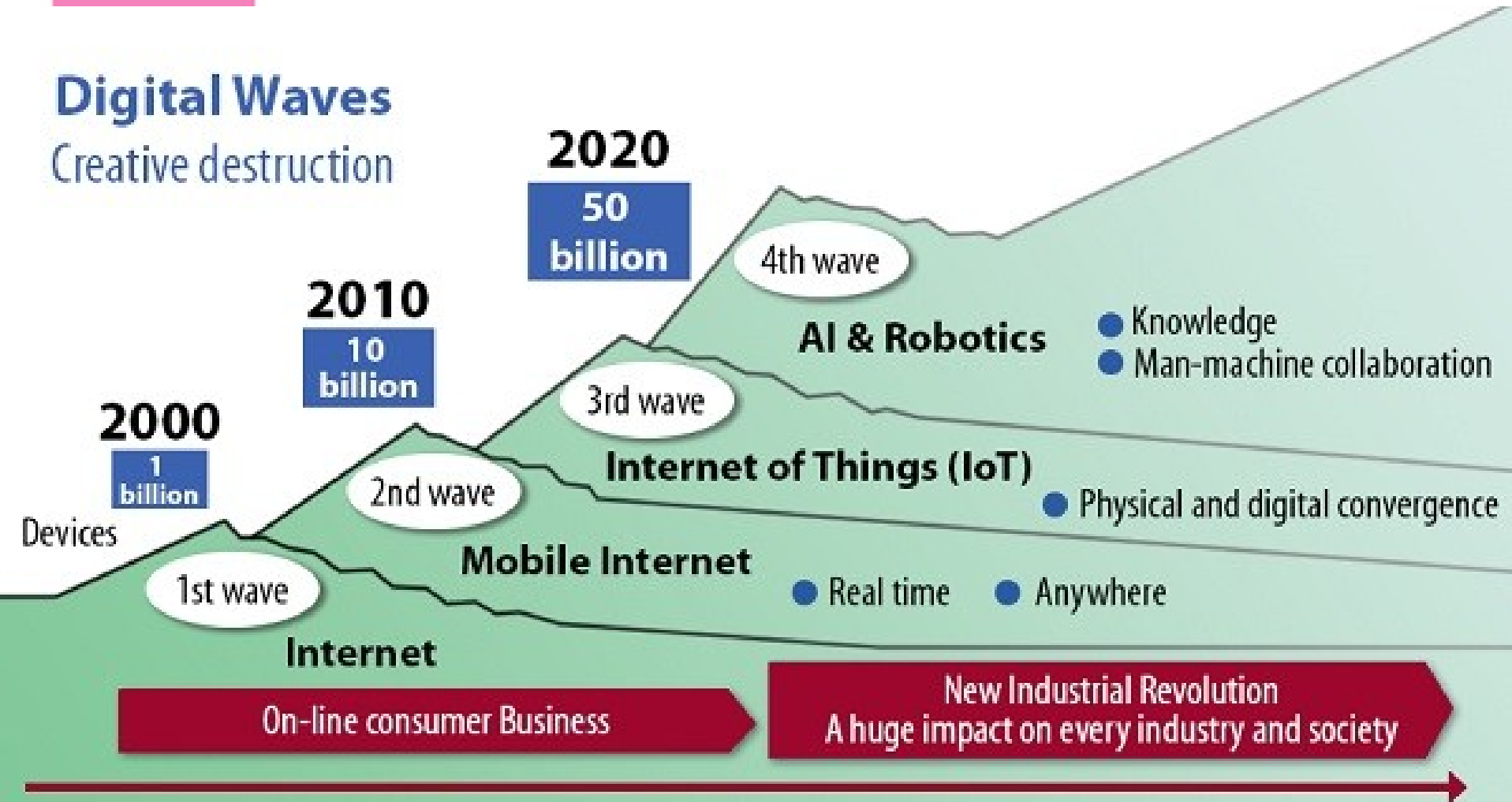


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# Digital Waves

## Digital Waves

Creative destruction





# AI $\rightarrow$ ML $\rightarrow$ DL

- **Artificial Intelligence** (1950s) – Giving intelligence to machine
- **Machine Learning** (1980s) – realizing artificial intelligence (speech recognition, image recognition, playing go, dialogue)
- **Deep Learning** (2006) – for machine learning for higher prediction accuracy
  - A powerful class of machine learning model
  - Modern reincarnation of artificial neural network
  - Collection of simple, trainable mathematical functions



# History of DL

- 1958: Rosenblatt's **Perceptron** algorithm
- 1969: Minsky showed **Perceptron** could not solve the XOR problem, connectedness, parity.
- 1986: Rumelhart developed **Backpropagation** algorithm to train neural network
- Mid 90's: Cortes and Vapnik published paper on **Support Vector Machines**
- 2006: Hinton and Salakhutdinov proposed using **Restricted Boltzmann Machine** for pre-train Deep Neural Network
- 2007: Fei-Fei Li's **ImageNet** assembling a database of 14 million labeled images (Data drives learning)



# History of DL

- 2011: Microsoft explored **Speech recognition** and IBM's **Watson**
- 2014: Google acquired **DeepMind**, combining deep learning and reinforcement learning
- 2016: DeepMind's **AlphaGo** defeated world champion Lee Sedol



# DL Application

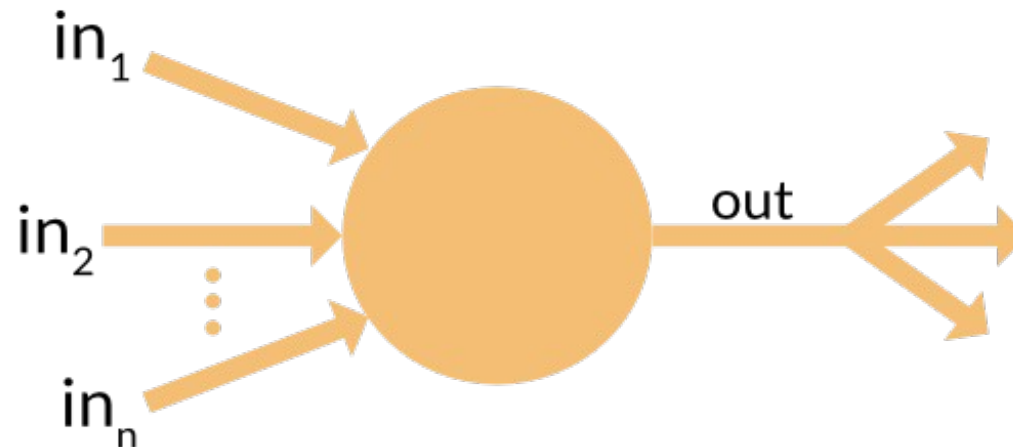
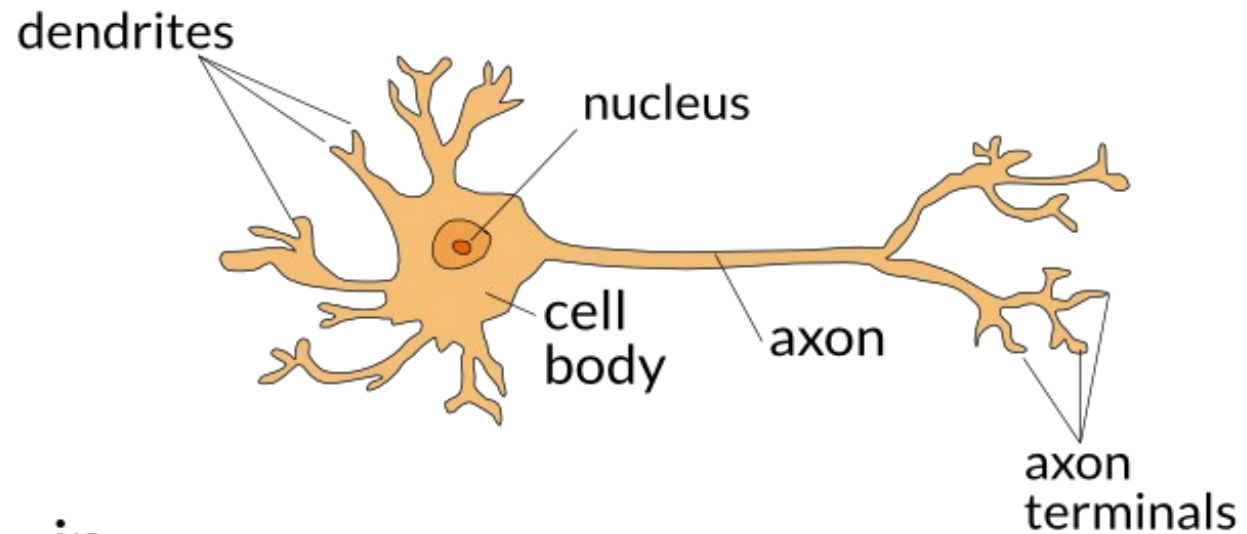
- **Google:** 2011 launched deep-learning focused project. 2014 bought DeepMind with AlphaGo.
- **Microsoft:** strong in speech-recognition and translation
- **Facebook:** translate user posts in more than 40 languages
- **Baidu:** for speech recognition, translation, photo search and self-driving car project





# DL model

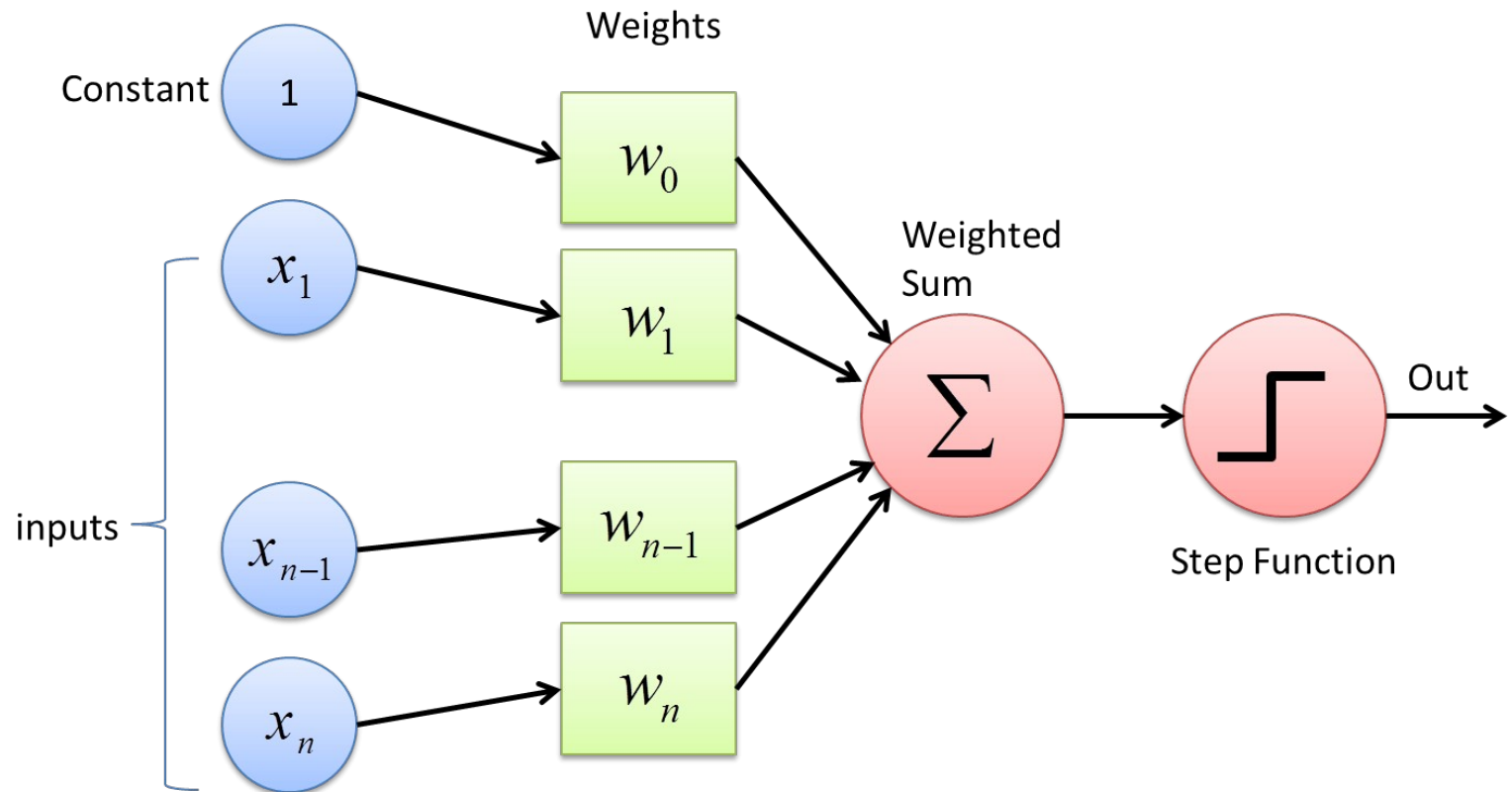
- **Perceptron:** Axons send signals to other cells while dendrites receive them.





# Neural network

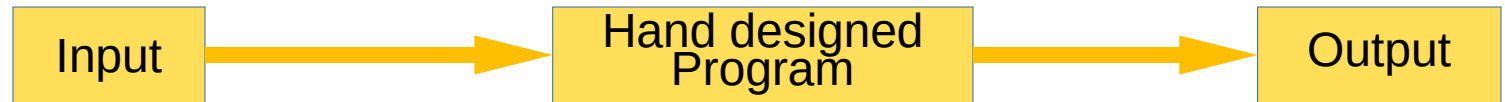
- Weights are the important elements in neural network model.





# ML vs. DL

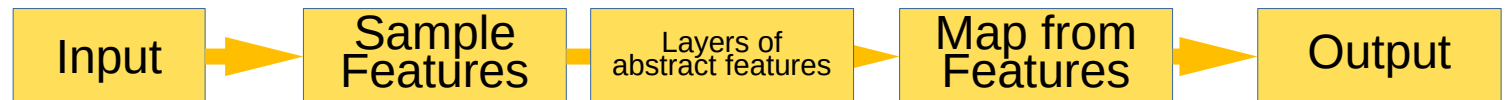
## Rules Based System



## Classic Machine Learning



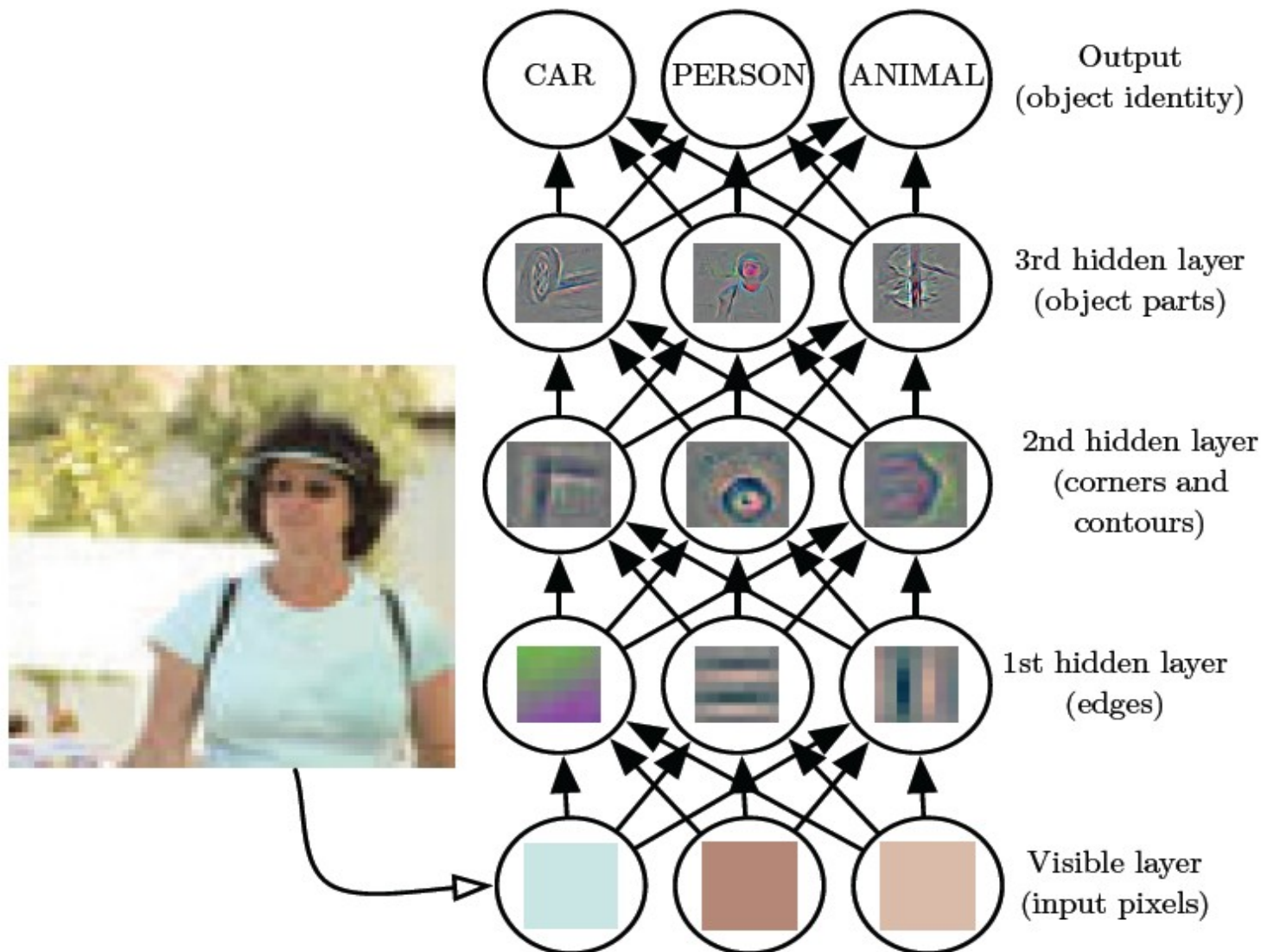
## Deep Learning





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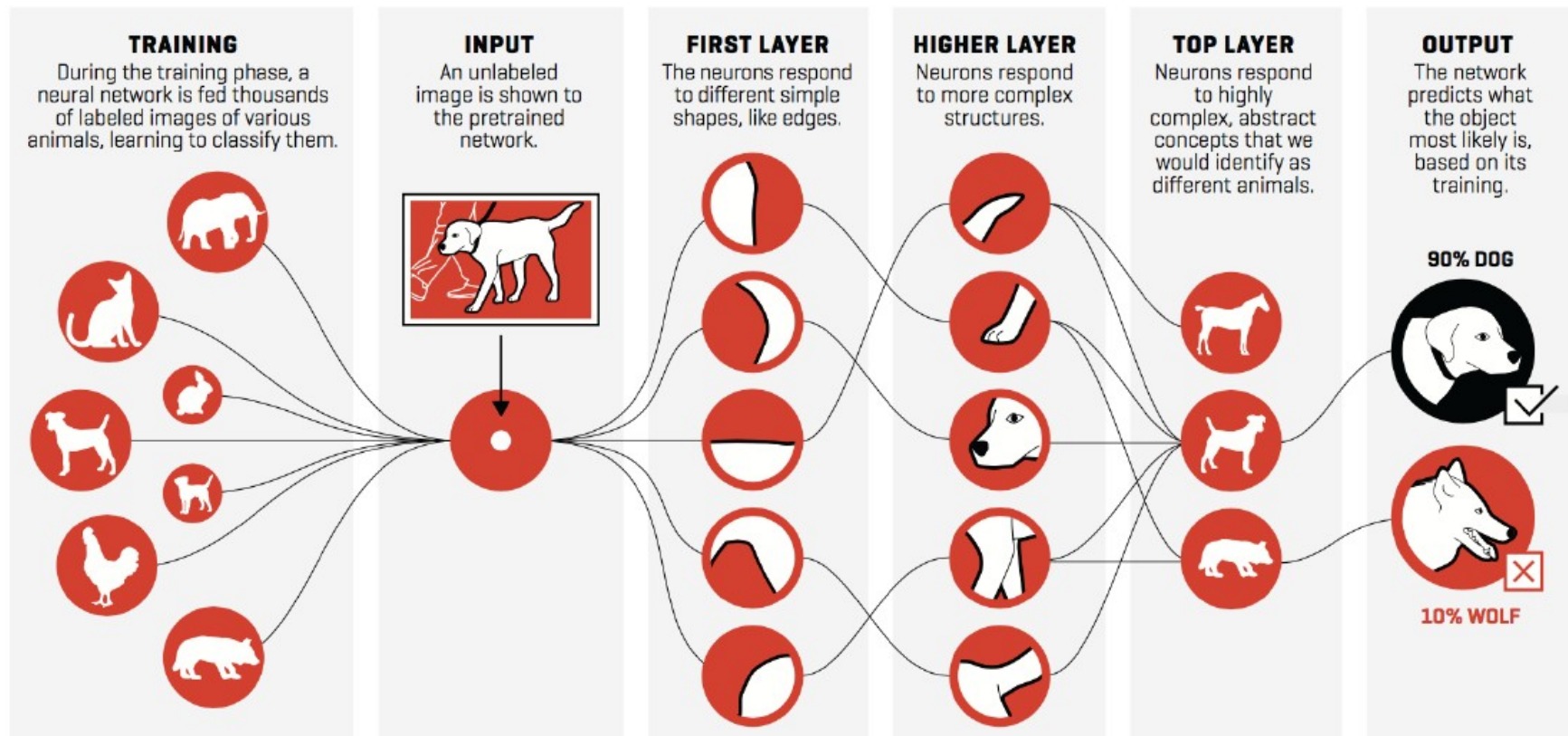
# DL model





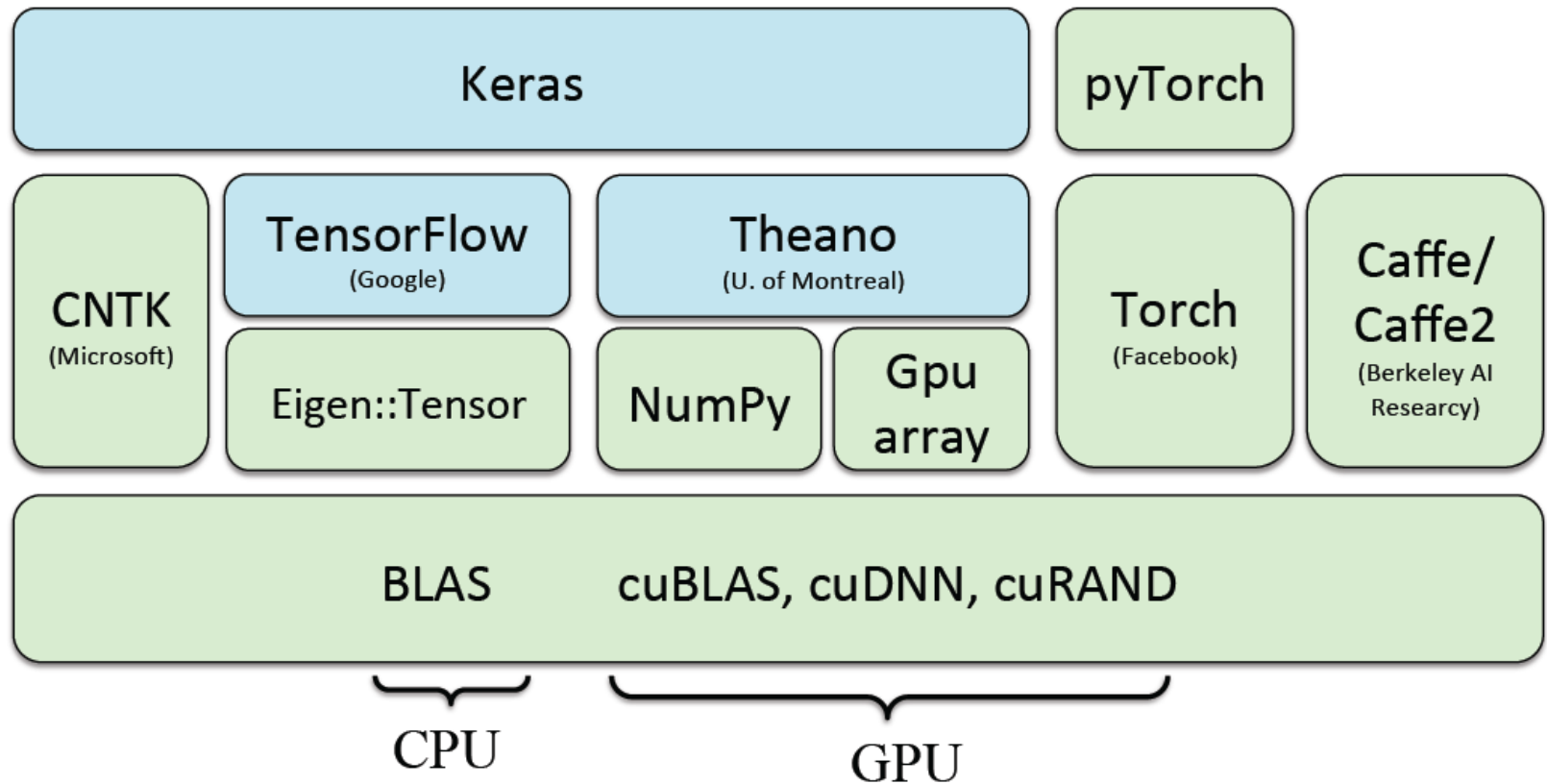
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# DL model





# DL software







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# Topics

- Introduction to deep learning
- Background: Numpy, linear algebra, probability, automatic differentiation
- Implementation of a linear regression and a logistic regression
- Softmax regression and regularization
- Perceptron and multilayer perceptron
- Convolutional neural network
- Architecture of CNNs: Alexnet, VGG
- Recurrent neural network
- Nonlinear optimization
- Gradient descent and stochastic gradient descent



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