A Brief Introduction to Deep Learning

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Outline

- **Background**
- **Deep Learning**
- **Open Questions**

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- **Deep Learning**
- **Open Questions**

Background

Can computers think?

A question raised by Alan Turing in “Computing Machinery and Intelligence”, 1950

Background

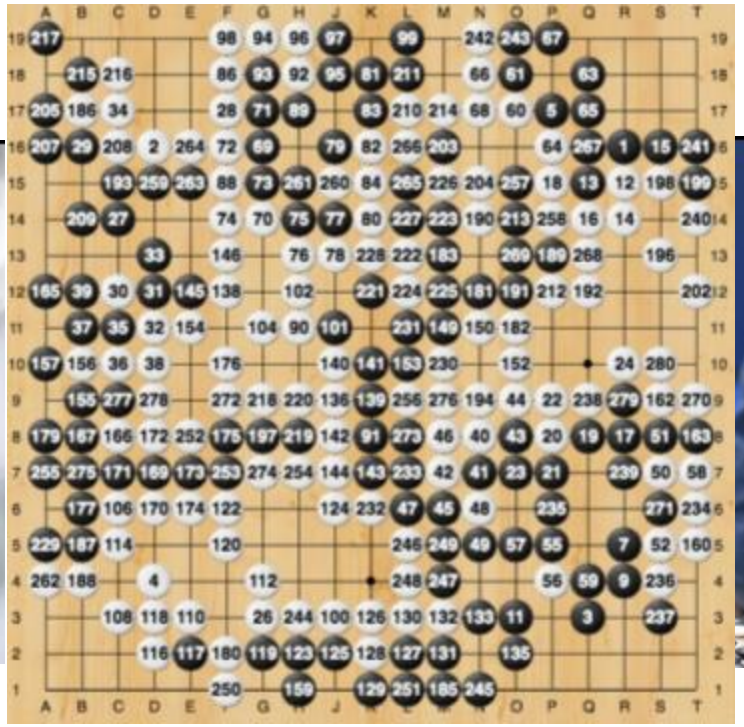
- Artificial intelligence (AI) is intelligence exhibited by machines.
- In computer science, an ideal "intelligent" machine is a flexible rational agent that perceives its environment and takes actions that maximize its chance of success at some goal. https://en.wikipedia.org/wiki/Artificial_intelligence

Background

- **IBM Watson**

Background

- Google AlphaGO
  - Deep Reinforcement Learning

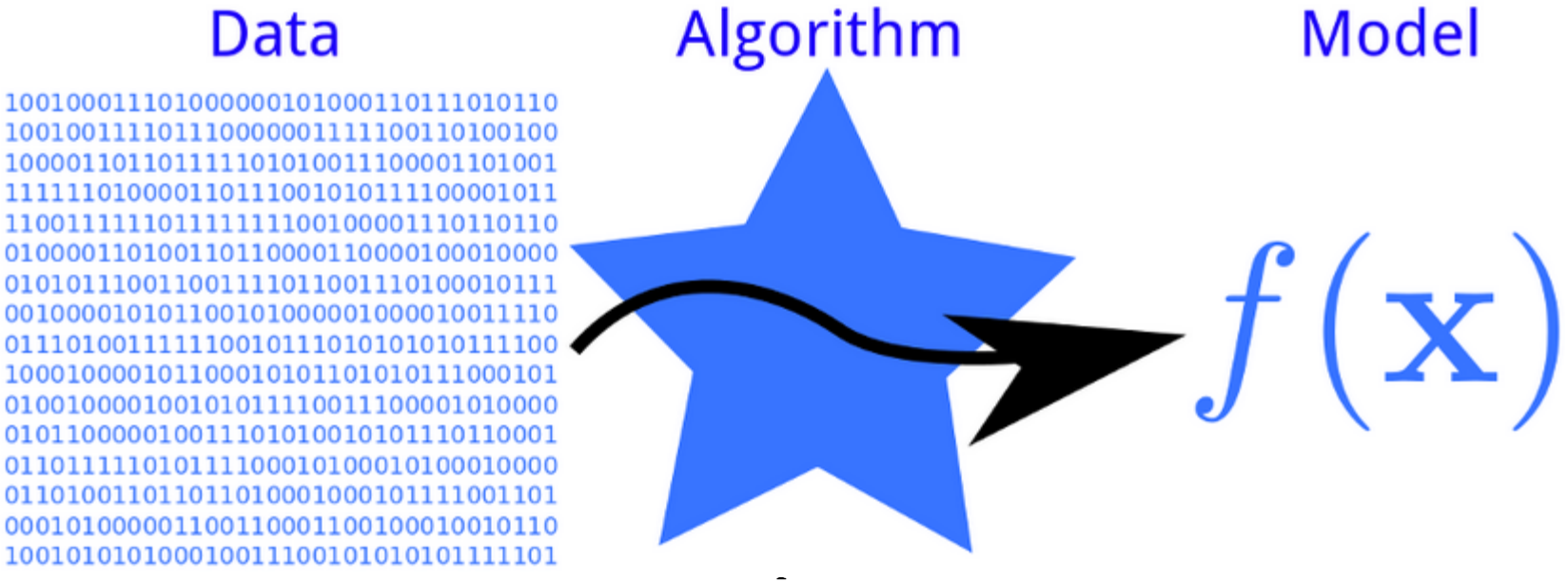


Background

- **Key Technology**
  - **Knowledge Engineering**
  - **Natural Language Processing**
  - **Data Base**
  - **Machine Learning**
  - **… …**

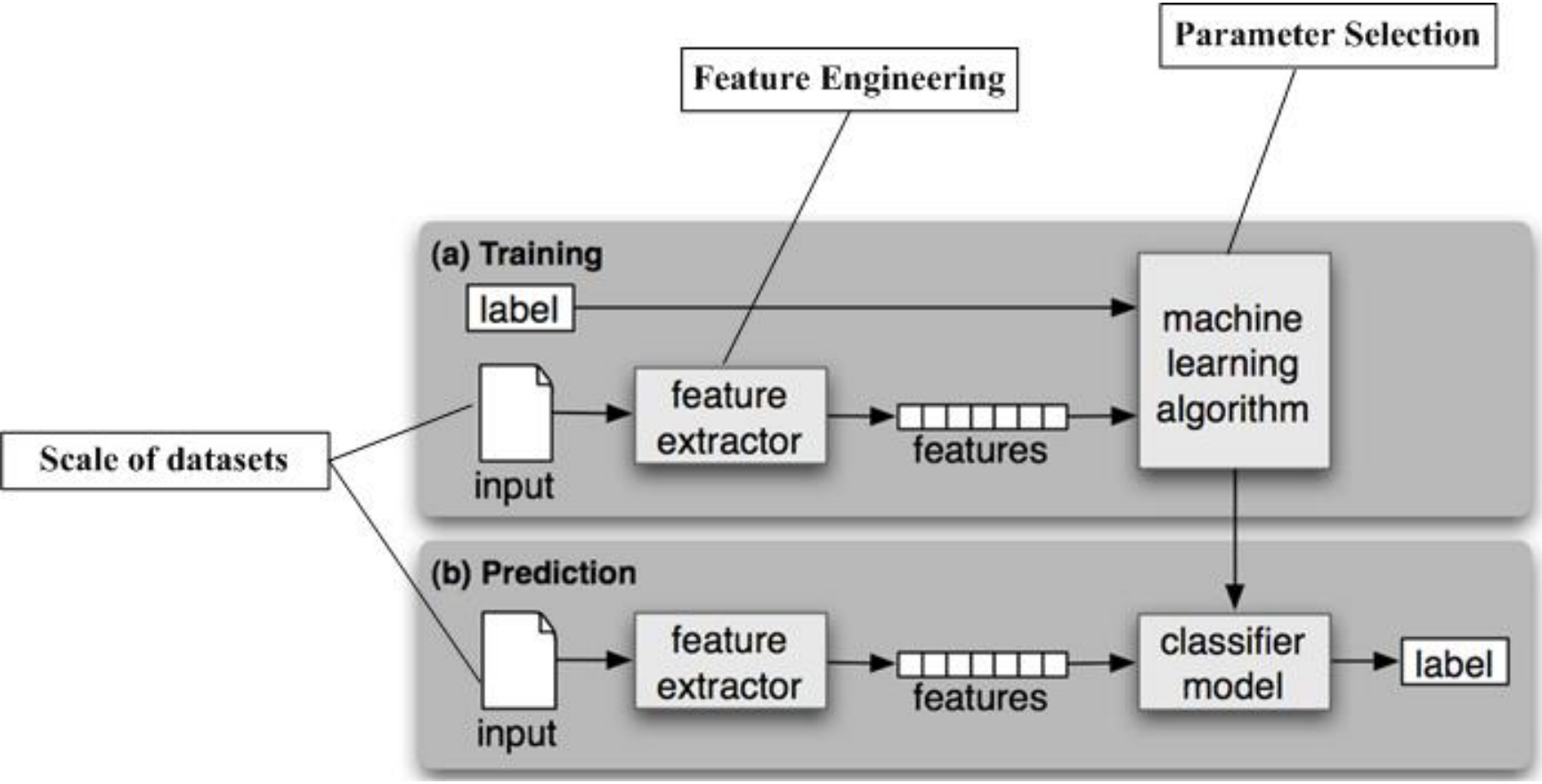
Background

- **Machine Learning** systems automatically learn programs from data to generate a model.



Background

- **Supervised Machine Learning (SML)**



Background

- **Currently, the most successful SML for BIG DATA analytics is Deep Learning Based SML.**

Outline

- **Background**
- **Deep Learning**
- **Open Questions**

Deep Learning

- Neurological Basis
- Development History
- Convolutional Neural Network

Deep Learning

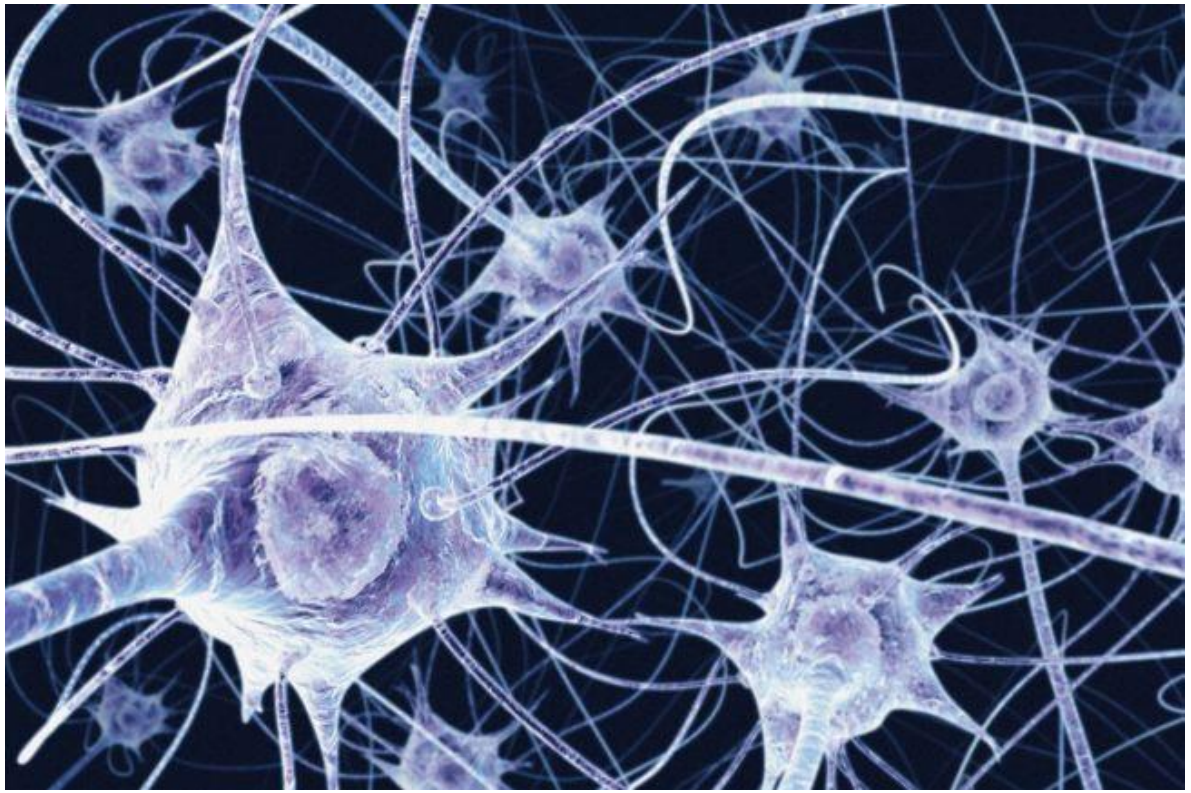
- Neurological Basis
- Development History
- Convolutional Neural Network

Deep Learning

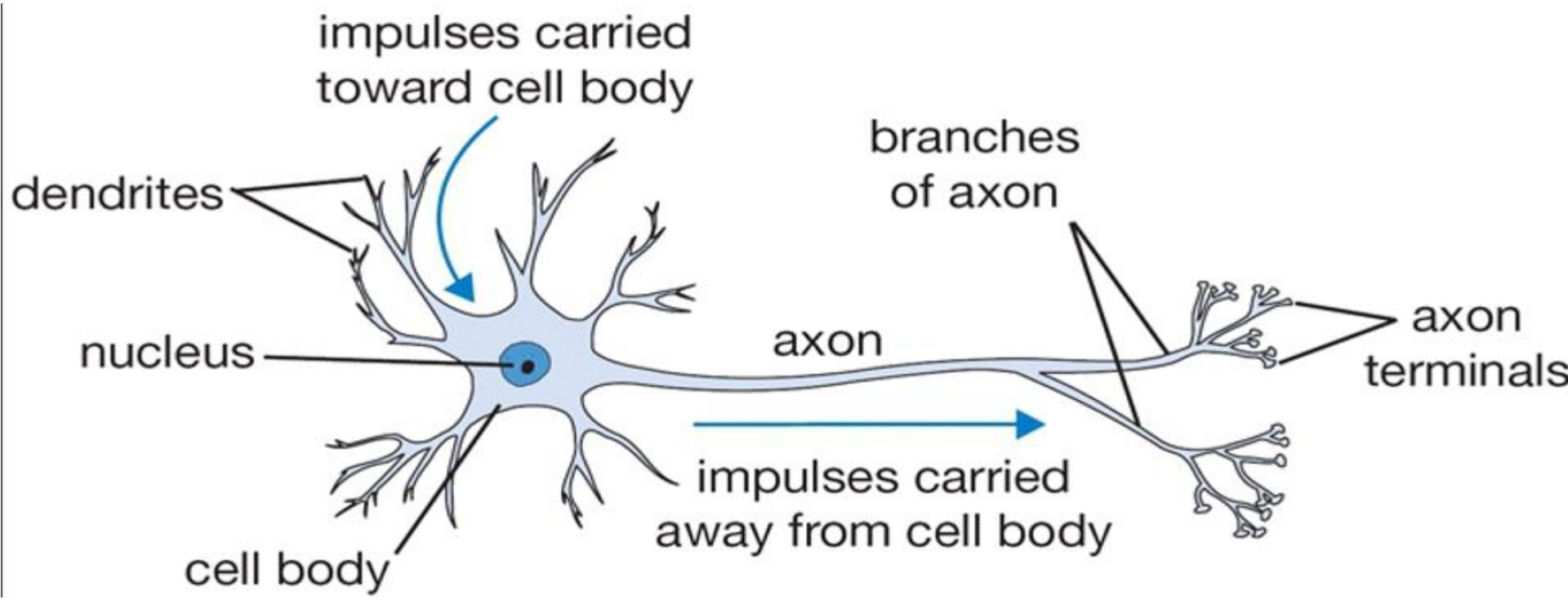
- Brain

Deep Learning

- Neuron



Deep Learning



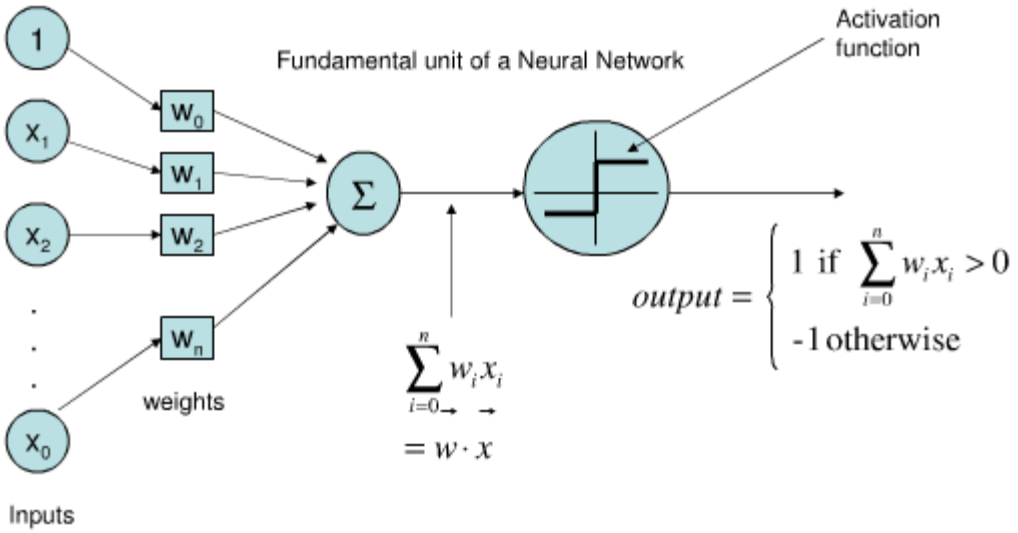
Deep Learning

- Neurological Basis
- Development History
- Convolutional Neural Network

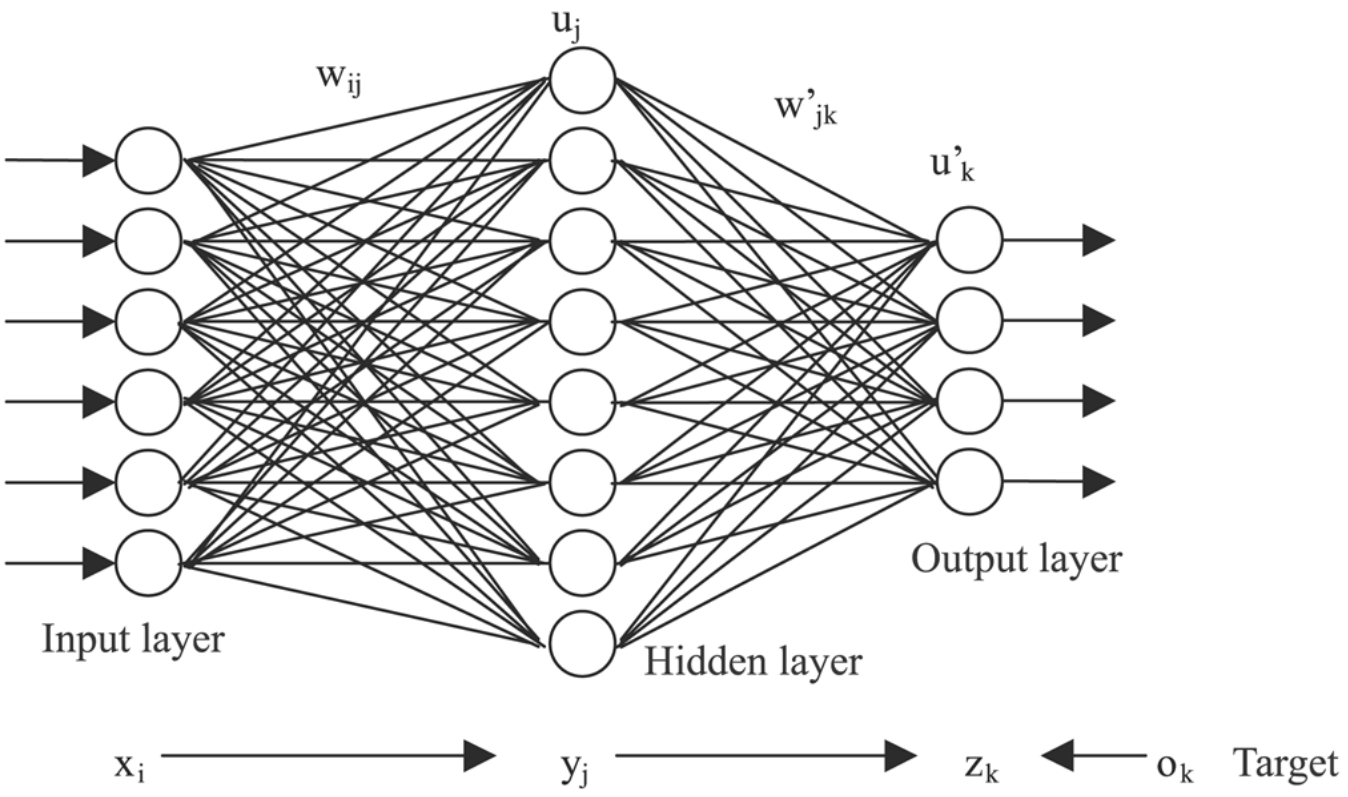
Deep Learning

- Development History
  - Perceptron
  - Neural Network

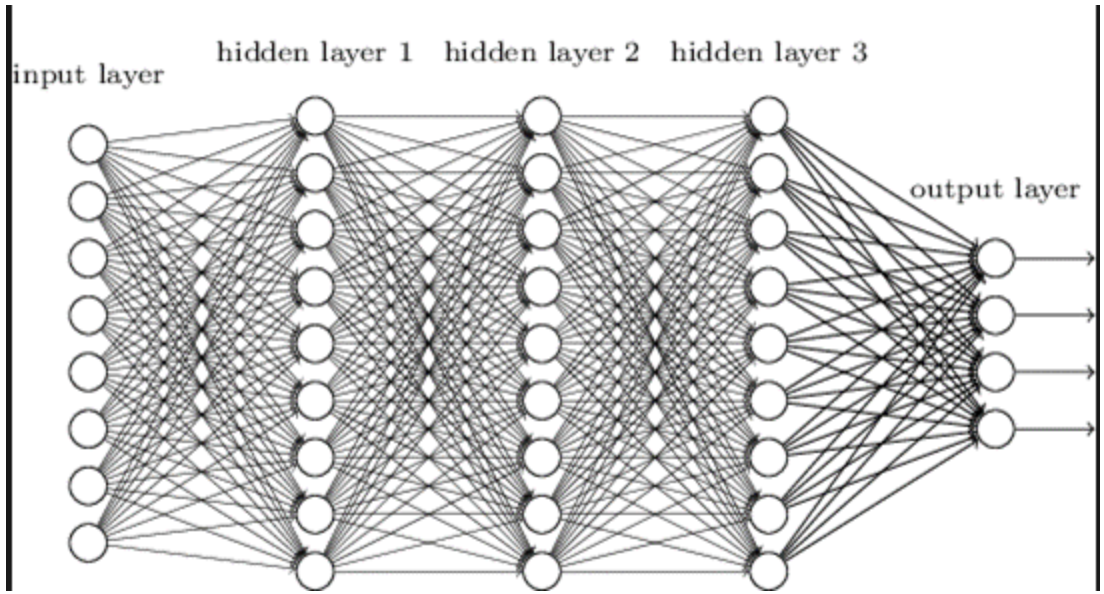
Perceptron


1
x1
x2
xn
x0
w0
w1
w2
wn
weights
Inputs
Fundamental unit of a Neural Network
Σ
Activation function
$\sum_{i=0}^{n} w_i x_i = \vec{w} \cdot \vec{x}$
$output = \begin{cases} 1 \text{ if } \sum_{i=0}^{n} w_i x_i > 0 \\ -1 \text{ otherwise} \end{cases}$

Neural Network



Deep Neural Network



Deep Learning

Deep Neural Network

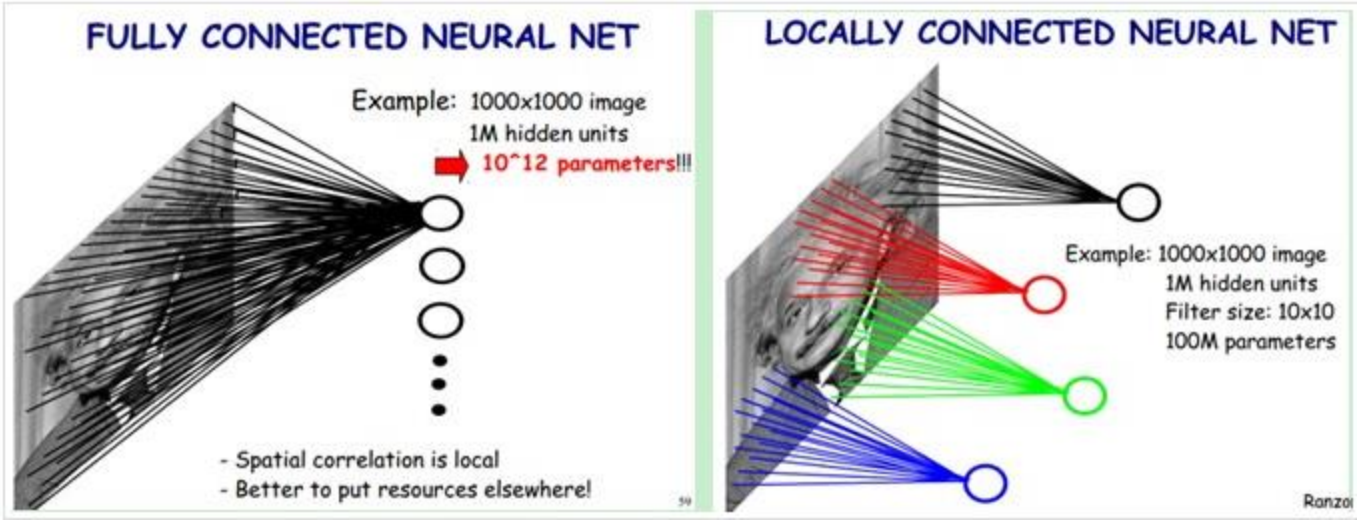
- Supervise Machine Learning
  - Convolutional Neural Network (CNN)
  - Recurrent Neural Networks (RNN)
- Unsupervised Machine Learning
  - Deep Belief Network (DBN)
- Deep Reinforcement Learning

Deep Learning

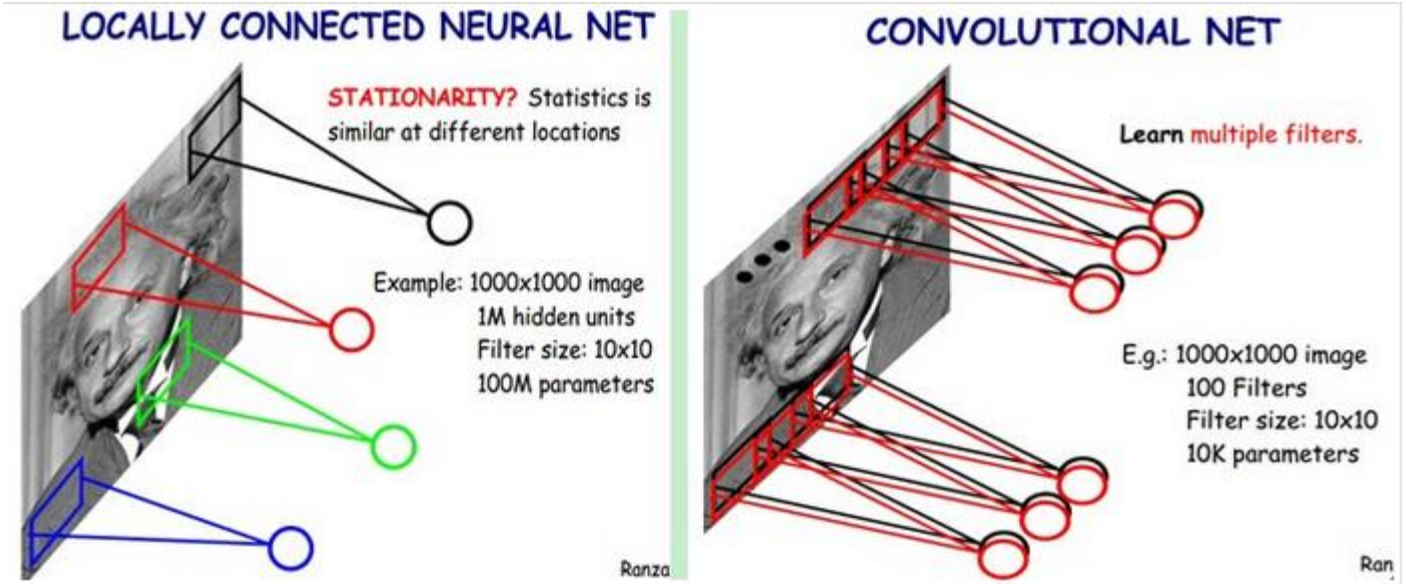
- Neurological Basis
- Development History
- Convolutional Neural Network

Convolutional Neural Network

- **Image Processing**



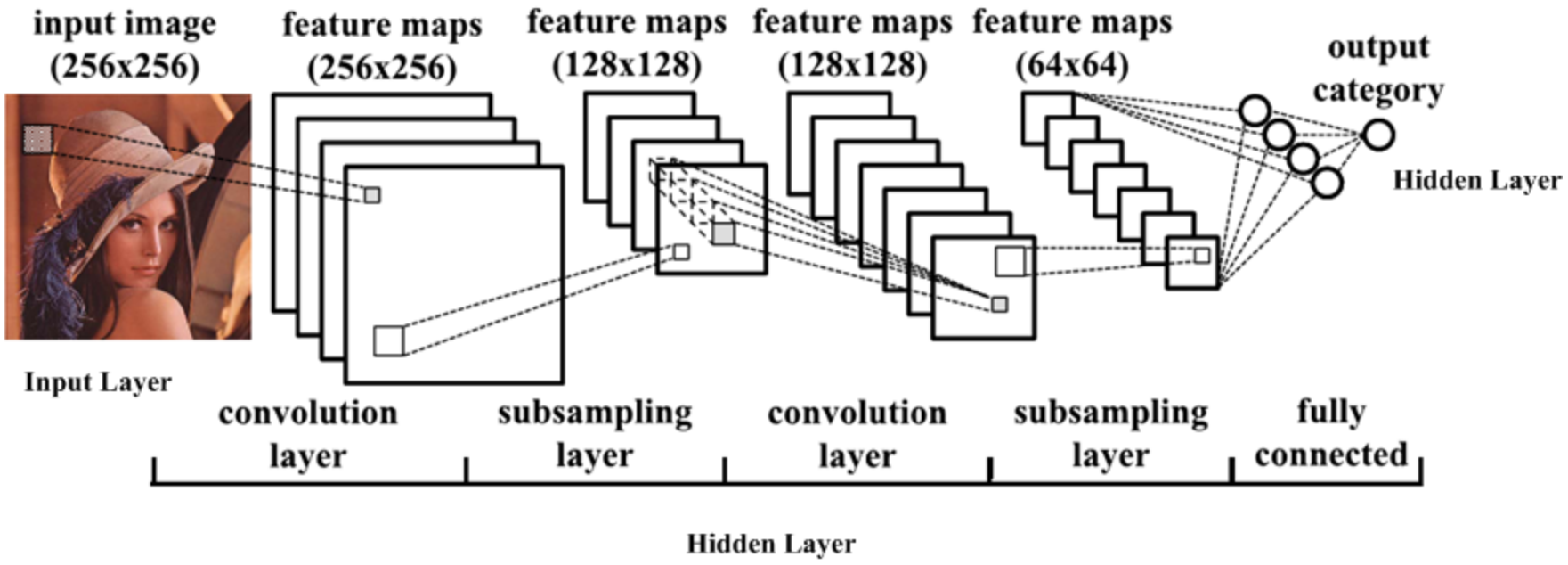
Convolutional Neural Network



Convolutional Neural Network

- **Input Layer**
- **Hidden Layer**
  - **Convolution Layer**
  - **Pooling Layer (Subsampling Layer)**
  - **Fully Connected Layer**
- **Output Layer**

Convolutional Neural Network



Convolutional Neural Network

- **Applications**
  - **Image processing**
    - **Image Classification**
  - **Natural Language Processing**
    - **Sentence Classification**
  - **… …**

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Open Questions

- **LEARNING STRUCTURE of NETWORK AUTOMATICALLY**
- **UNSUPERVISED DEEP LEARNING**
- **… …**

Thank you!

Q&A