Deep Learning

СМИРНОВ В.Э. КТМО1-8

Contents

Glossary

Neuron – mathematical function conceived as a model of biological neurons, a neural network.

Neural Networks – computing systems vaguely inspired by the biological neural networks that constitute animal brains.

Activation function of a node defines the output of that node, or "neuron" given an input or set of inputs.

Deep Learning, Machine Learning and AI

ARTIFICIAL INTELLIGENCE

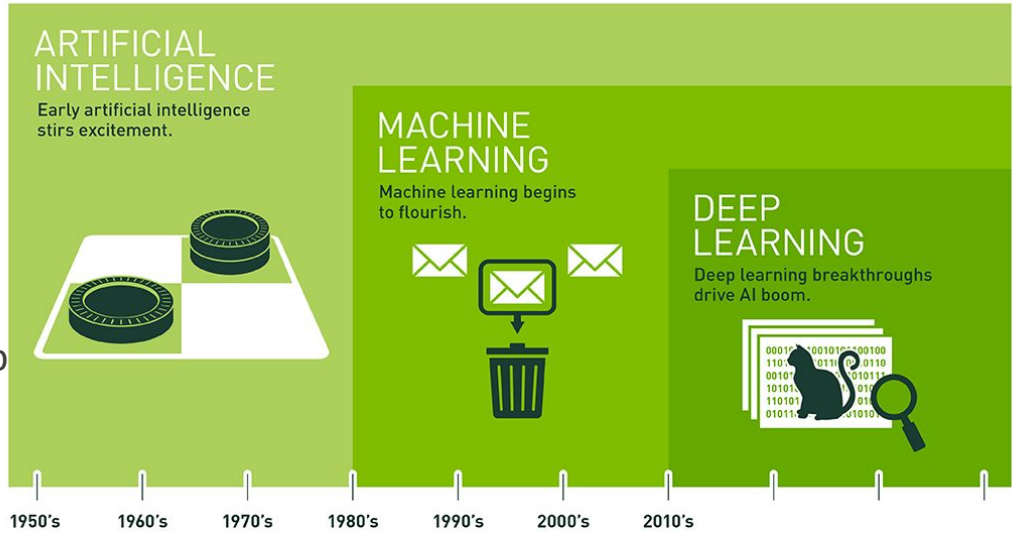
- AI is the broadest term, applying to any technique that enables computers to mimic human intelligence, using logic, if-then rules, decision trees, and machine learning (including deep learning.

MACHINE LEARNING

- The subset of AI that includes abstruse statistical techniques that enable machines to improve at tasks with experience. The category includes deep learning.

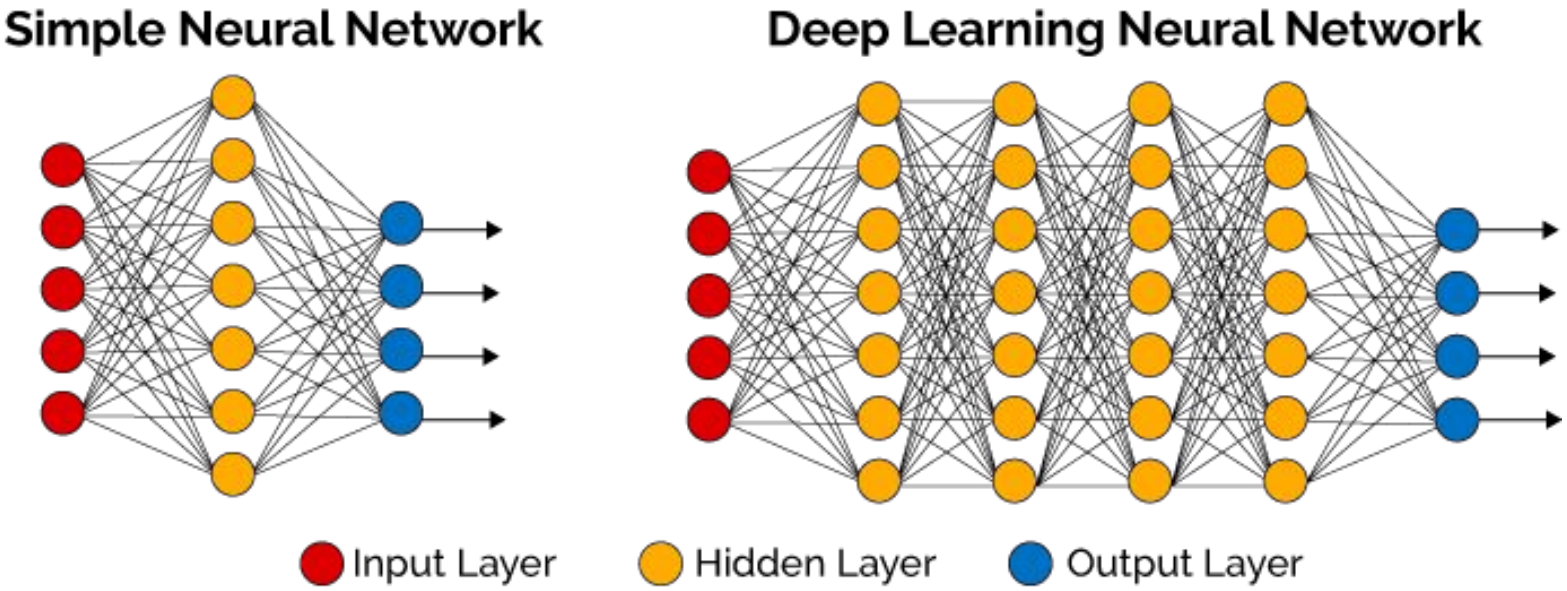
DEEP LEARNING

- The subset of machine learning composed of algorithms that permit software to train itself to perform tasks, like speech and image recognition, by exposing multilayered neural networks to vast amounts of data.



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Deep Neural Network



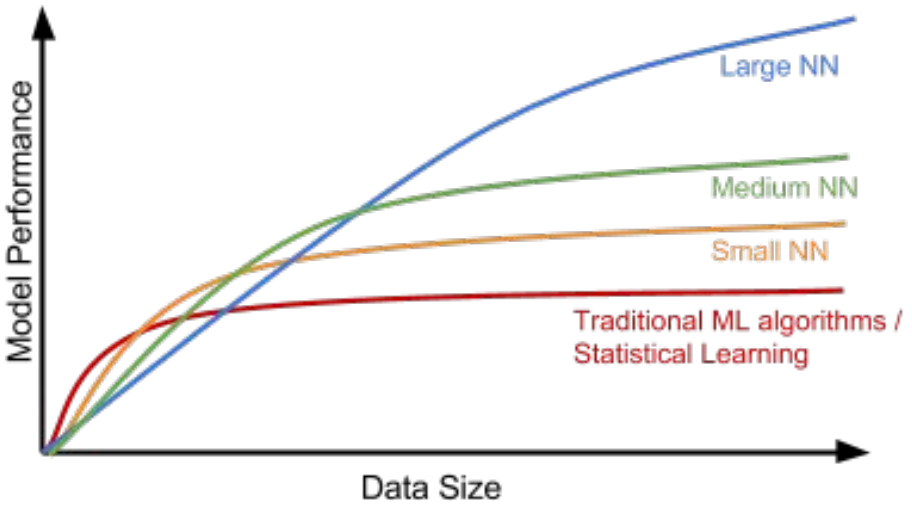
Why is Deep Learning Important now?

Deep learning requires large amounts of data

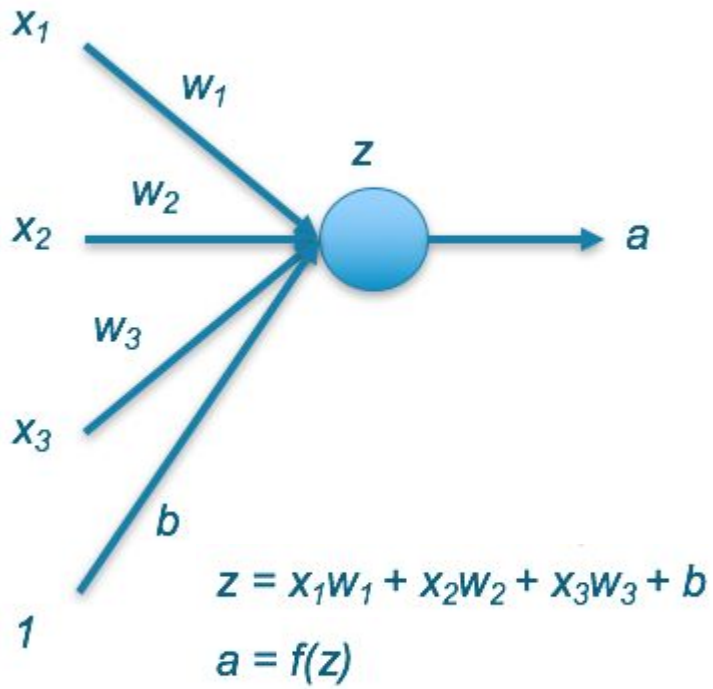
Deep learning requires substantial computing power

- High-performance GPUs have a parallel architecture that is efficient for deep learning

Well-trained Deep Neural Network can handle tasks that were previously considered impossible



What is a neuron?



The **x** values refer to inputs, either the original features or inputs from a previous hidden layer

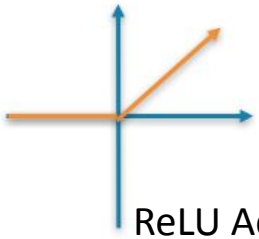
At each layer, there is also a bias **b** which can help better fit the data

The neuron passes the value **a** to all neurons it is connected to in the next layer, or returns it as the final value

What is an Activation Function?

Linear function

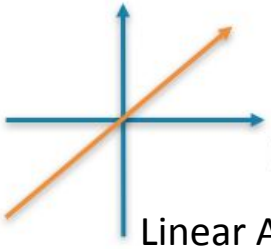
Non-linear function



$$relu(z) = \max(0, z)$$

Range: 0 to infinity

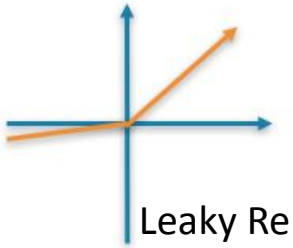
ReLU Activation Function



$$f(z) = az$$

Range: -infinity to infinity

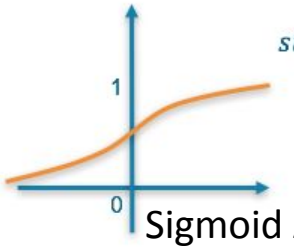
Linear Activation Function



$$leakyrelu(z) = \begin{cases} 0.01z & for\ z < 0 \\ z & for\ z \geq 0 \end{cases}$$

Range: -infinity to infinity

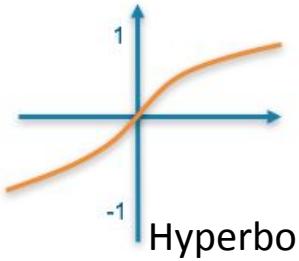
Leaky ReLU Activation Function



$$sigmoid(z) = \frac{1}{1 + e^{-z}}$$

Range: 0 to 1

Sigmoid Activation Function

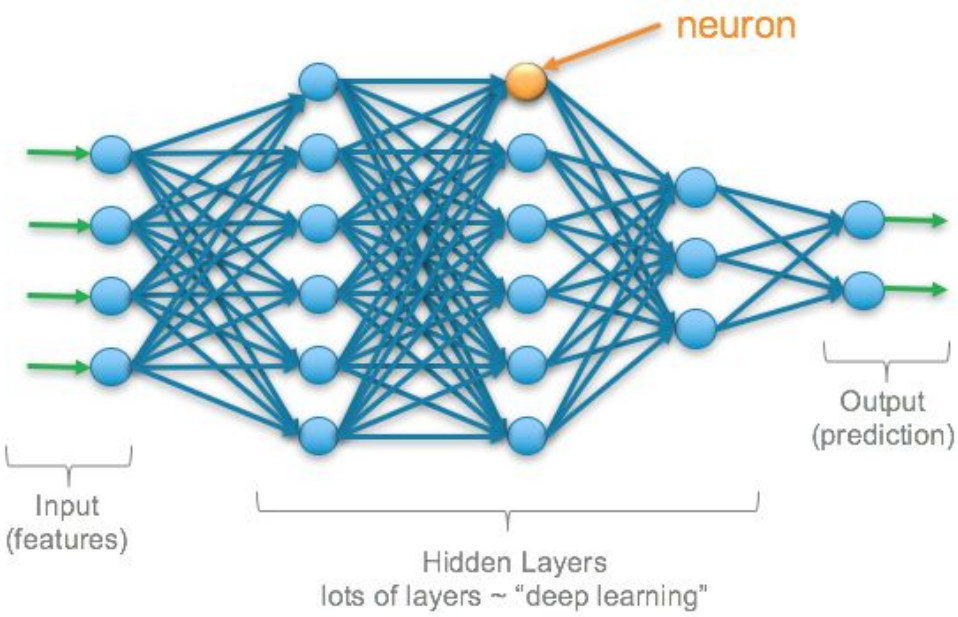


$$\tanh(z) = \frac{e^{z} - e^{-z}}{e^{z} + e^{-z}}$$

Range: -1 to 1

Hyperbolic Tangent Activation Function

Neural network is just a function…



that represented by various **combinations** of **neurons**, their **connections** and neuron **activation functions**.

According to **Universal approximation theorem**, any existing function can be approximated by a neural network.

Deep Learning Applications

Customer experience

Translations

Language recognition

Autonomous vehicles

News aggregator based on sentiment

Deep-learning robots

Healthcare

Automatic Text Generation

Image Recognition

Automatic Colorization Photo and Video

Advertising

Predicting Earthquakes

Text Generation

Music composition

Picture Generation

Restoring sound in videos

Data mining

Creating Deep Learning Networks

Example. Colorization



Colorado National Park, 1941



Textile Mill, June 1937

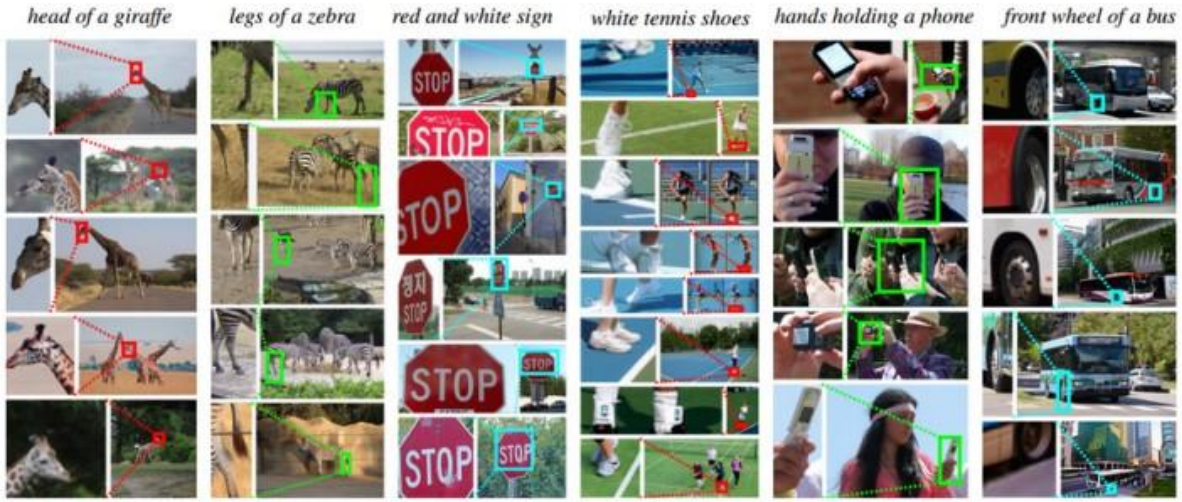


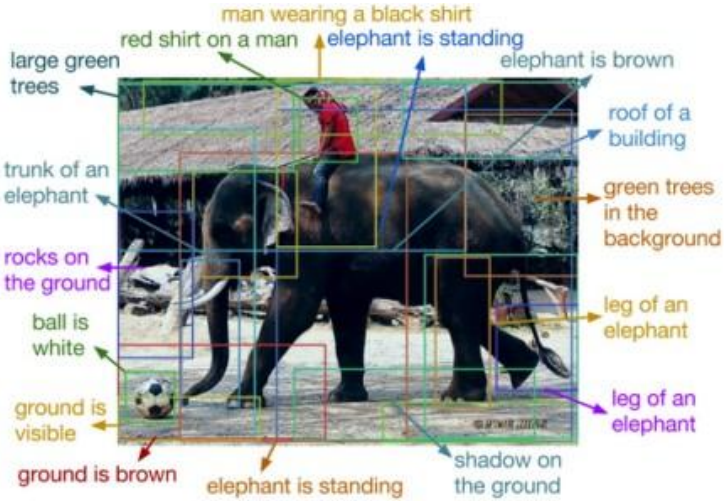
Berry Field, June 1909



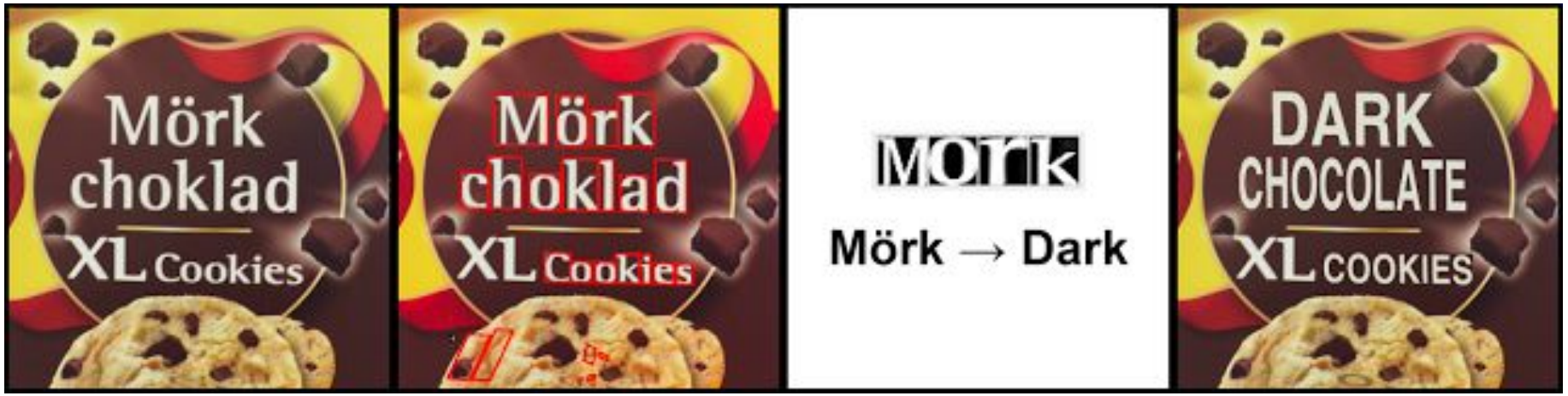
Hamilton, 1936

Example. Describing photos

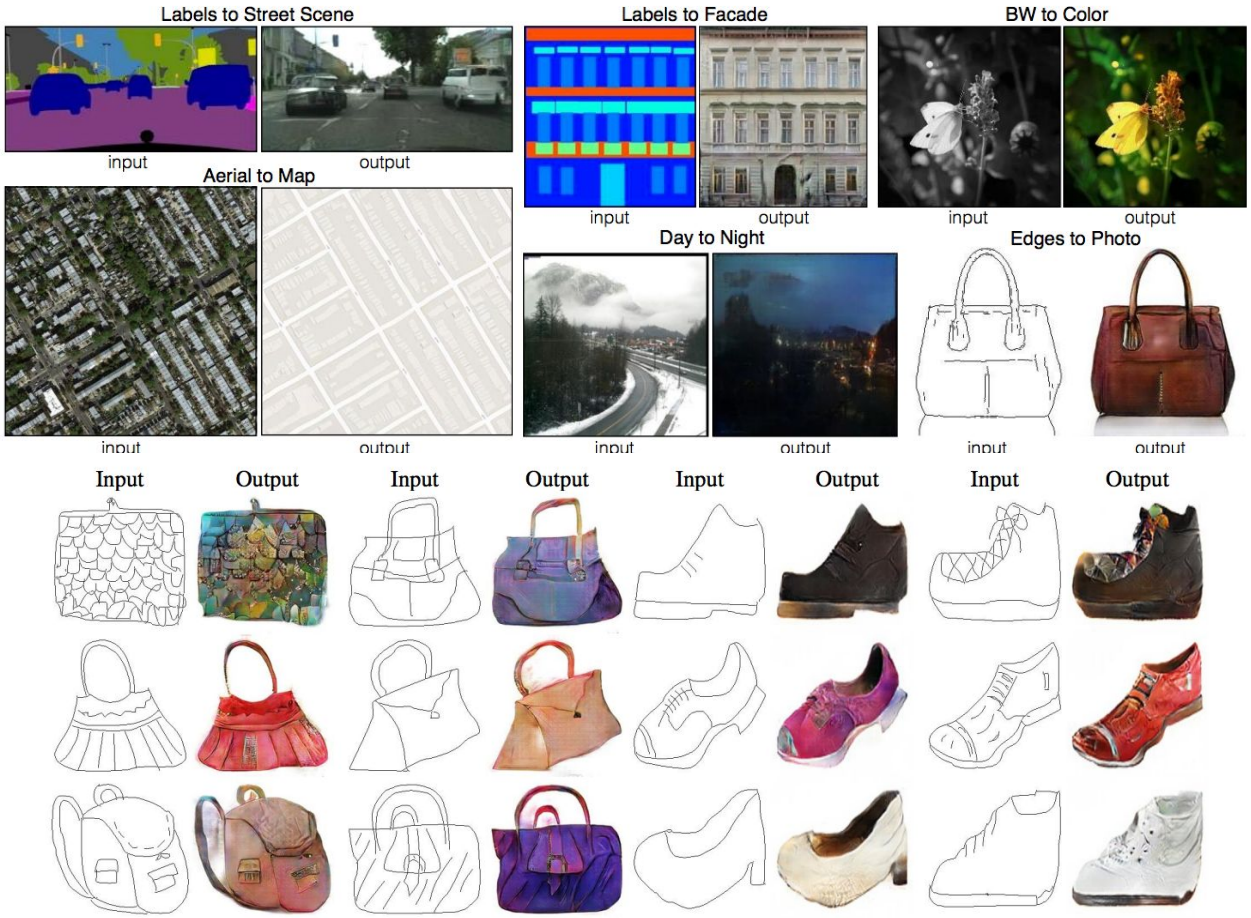




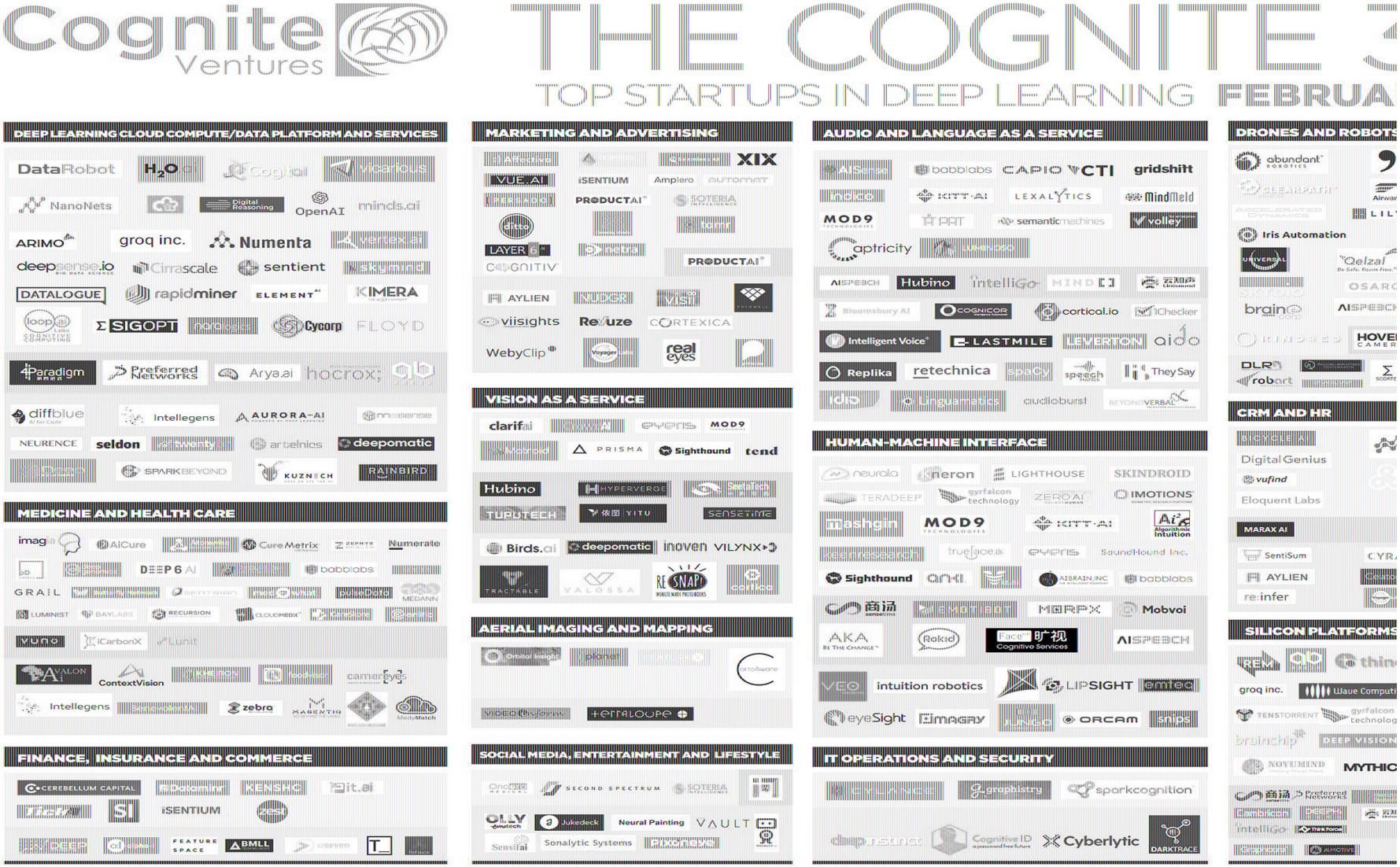
Example. Translation



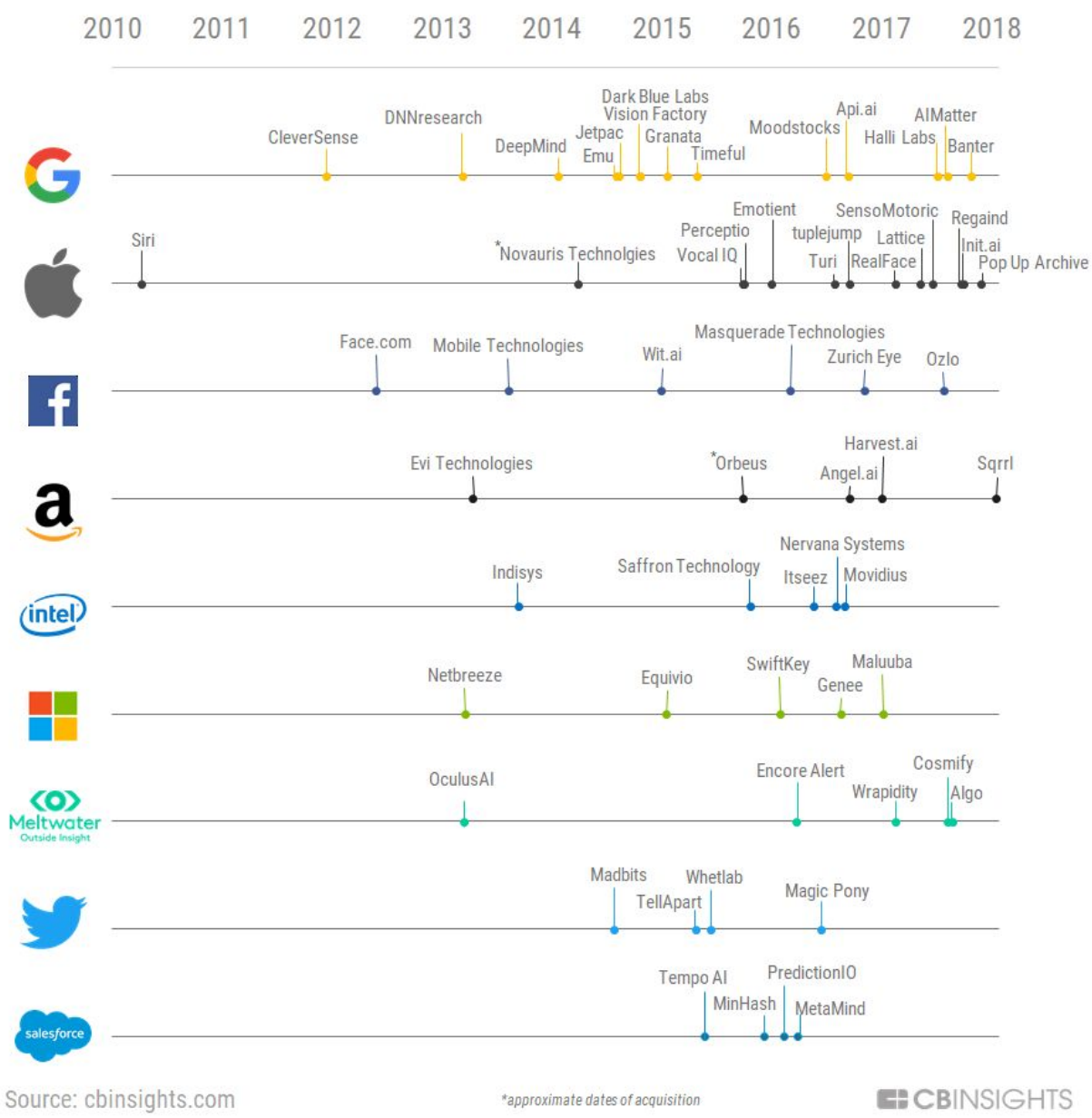
Example. Create new images



Top startups in Deep Learning



Race Ro Acquire Top AI Startups



Bibliography

https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

http://fortune.com/ai-artificial-intelligence-deep-machine-learning/

https://medium.com/@srnghn/deep-learning-overview-of-neurons-and-activation-functions-1d98286cf1e4

https://en.wikipedia.org/wiki/Universal_approximation_theorem

https://blog.algorithmia.com/introduction-to-deep-learning/

http://www.yaronhadad.com/deep-learning-most-amazing-applications/

http://www.cogniteventures.com/2018/02/22/the-latest-cognite-ventures-deep-learning-startup-list/

https://www.cbinsights.com/research/top-acquirers-ai-startups-ma-timeline/