Advanced Methods in Data Analysis II
Introduction
A.I. Machine learning and Deep learning

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2021

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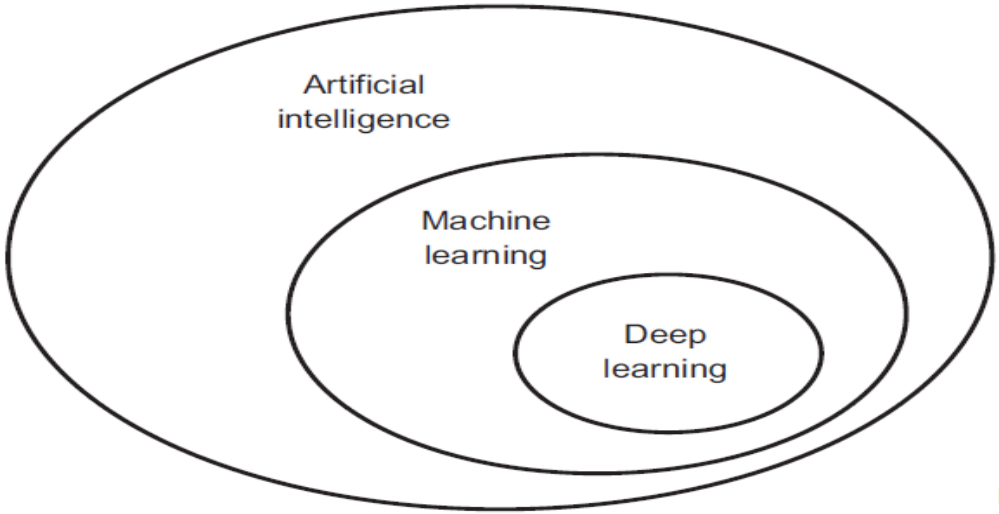
A.I. M.L. D.L. How do they relate to each other?



Artificial intelligence, machine learning, and deep learning

Source. Chollet (2018). Deep Learning with Python

- What is meant by learning in machine learning?

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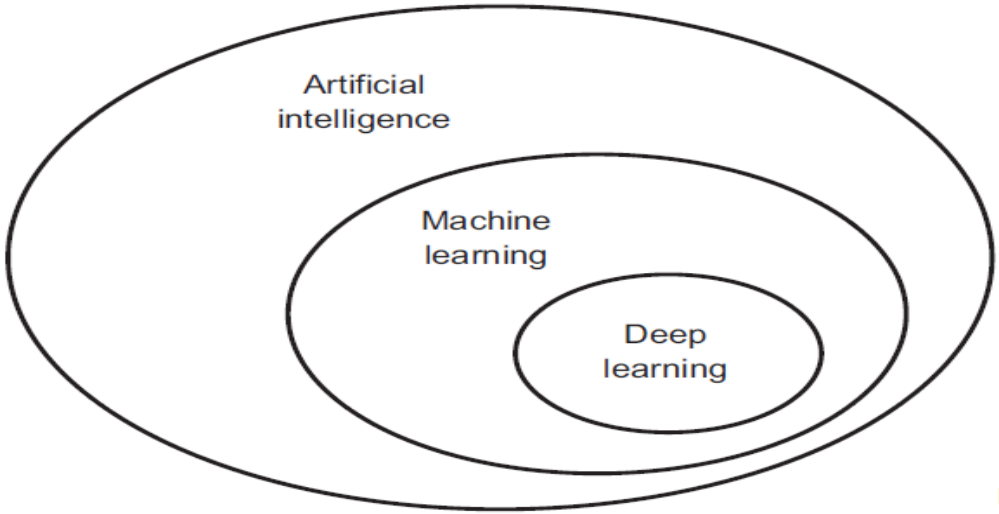

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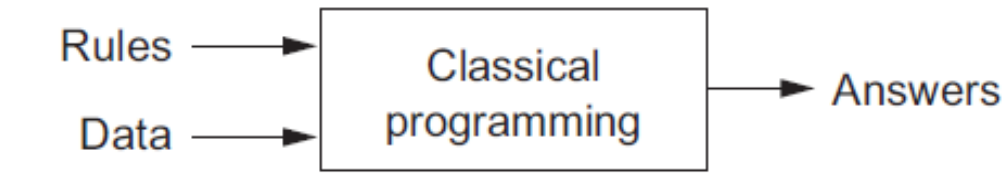

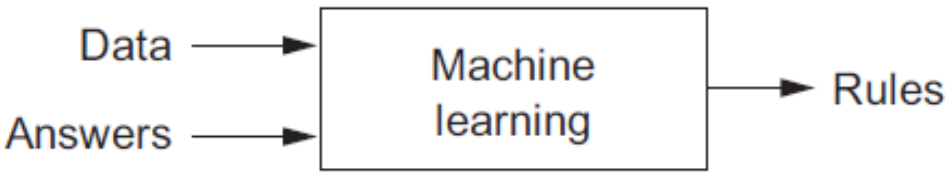

Machine learning: a new programming paradigm

Source. Chollet (2018). Deep Learning with Python

Learning in machine learning

To do machine learning, we need three things:

- Input data points

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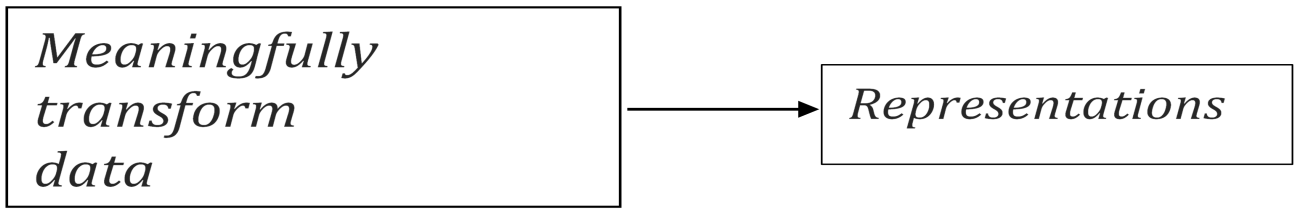

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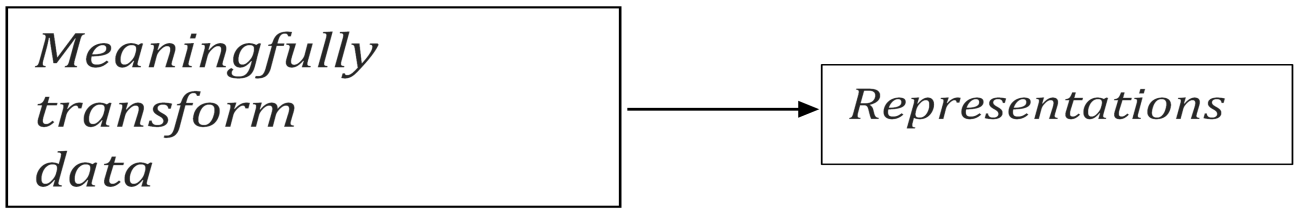
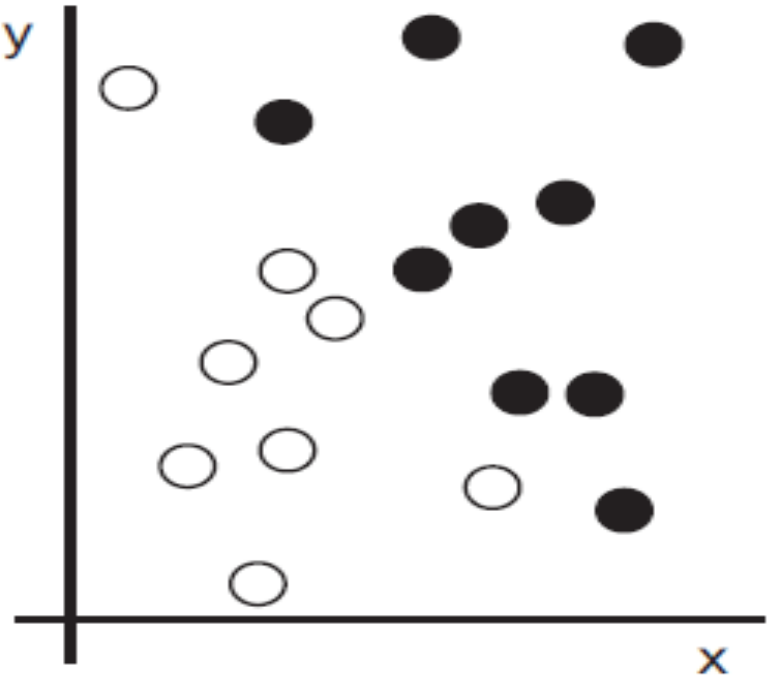


- Machine-learning models are all about finding appropriate representations for their input data

Learning in machine learning

Representations



We want to develop an algorithm that can take the coordinates (x, y) of a point and output whether that point is likely to be black or to be white.

Learning in machine learning

Would be a coordinate change

Learning in machine learning

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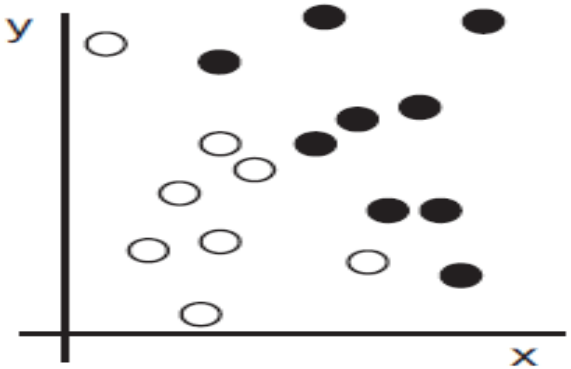
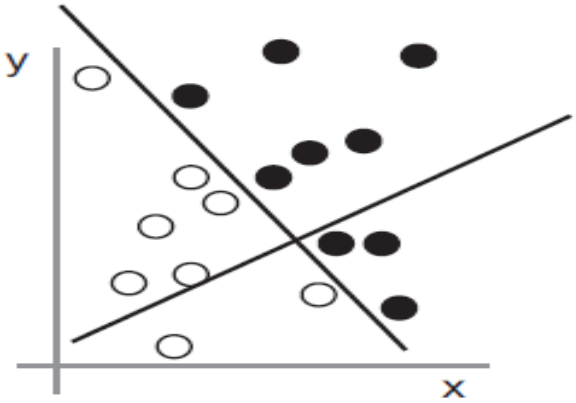


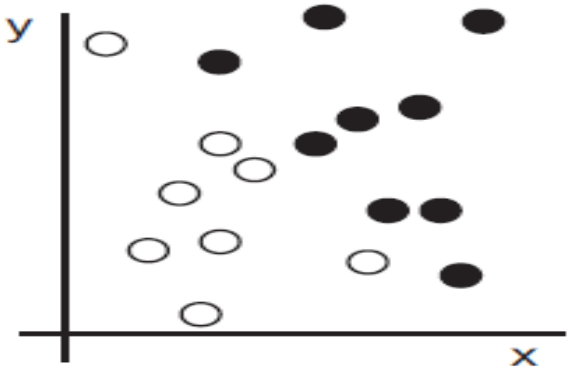
(a) Raw data.



(b) Coordinate change

Learning in machine learning

Would be a coordinate change



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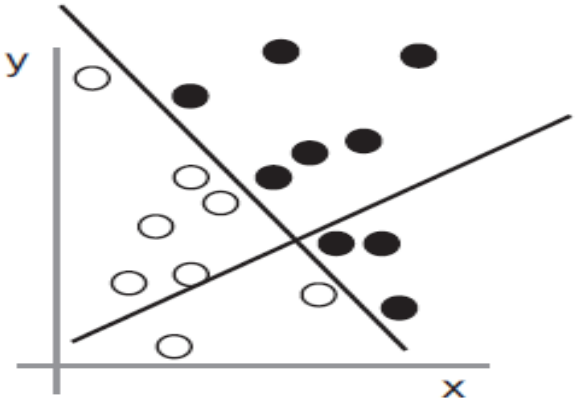

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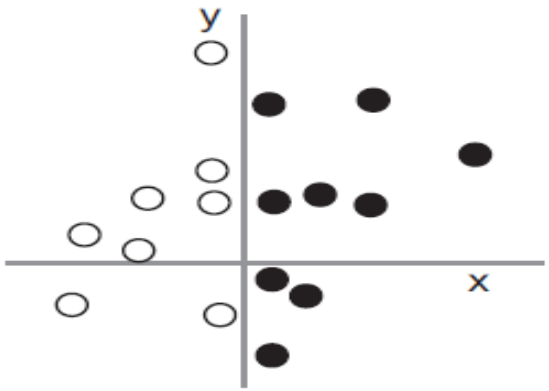

(c) Better representation

Learning in machine learning

All machine-learning algorithms consist of automatically finding such transformations that turn data into more-useful representations for a given task.

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Definition

Searching for useful representations of some input data, within a predefined space of possibilities, using guidance from a feedback signal

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Deep Learning and neural networks

First idea

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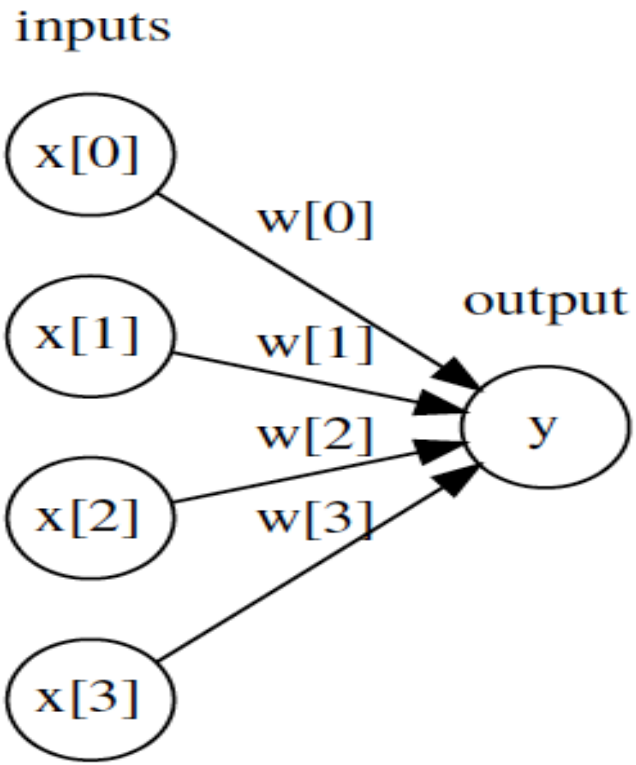

$$y = w_1 x_1 + ... + w_d x_d + b$$

Deep Learning

What does "deep" mean in Deep Learning?

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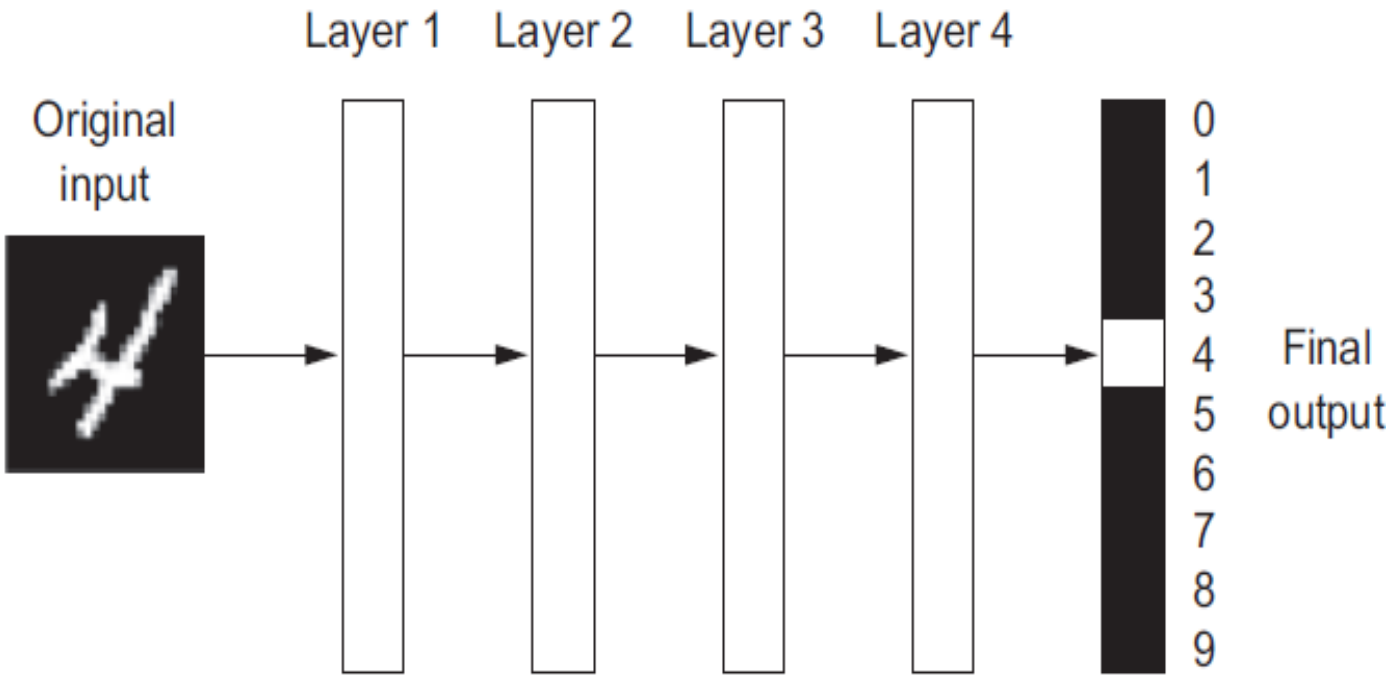

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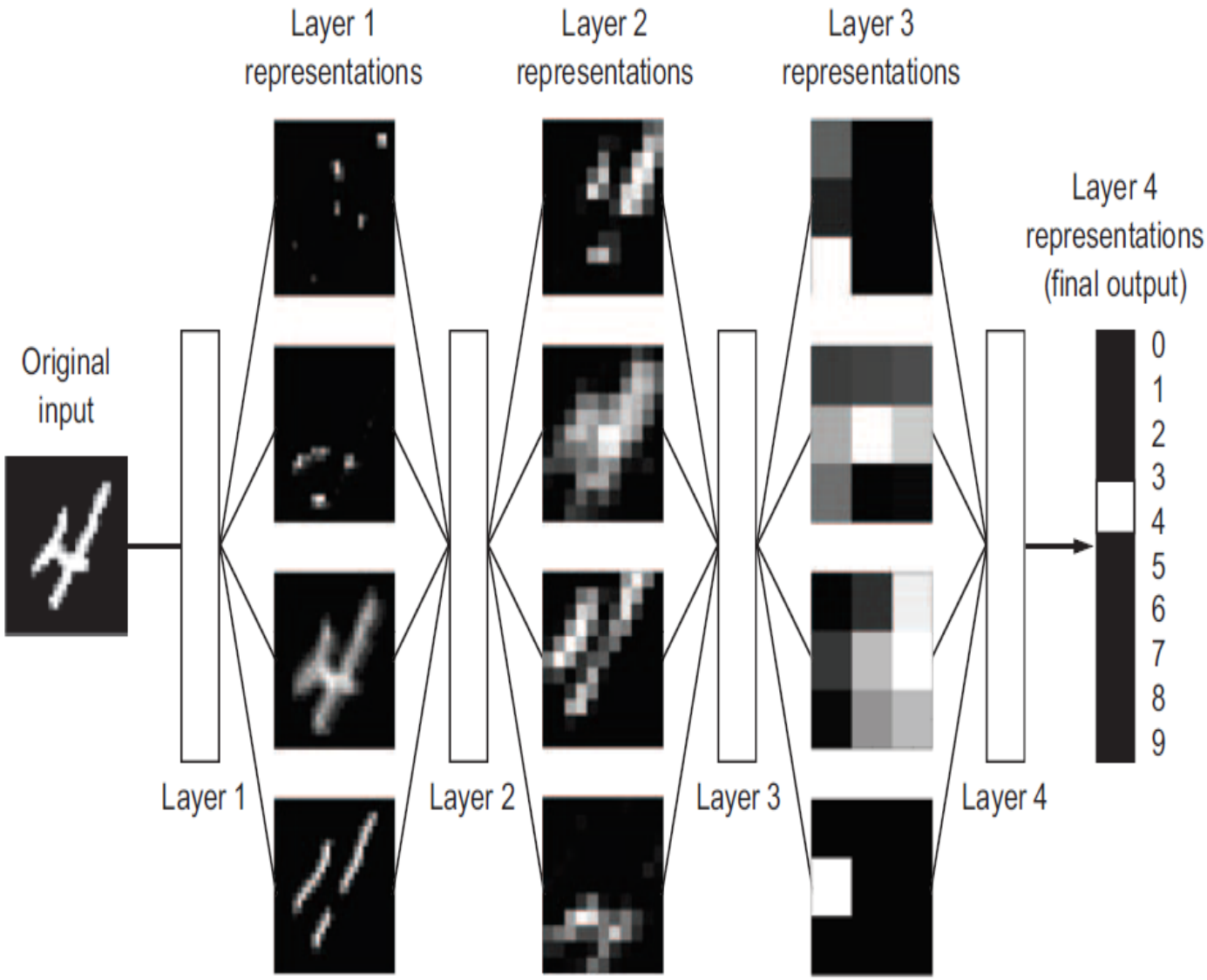

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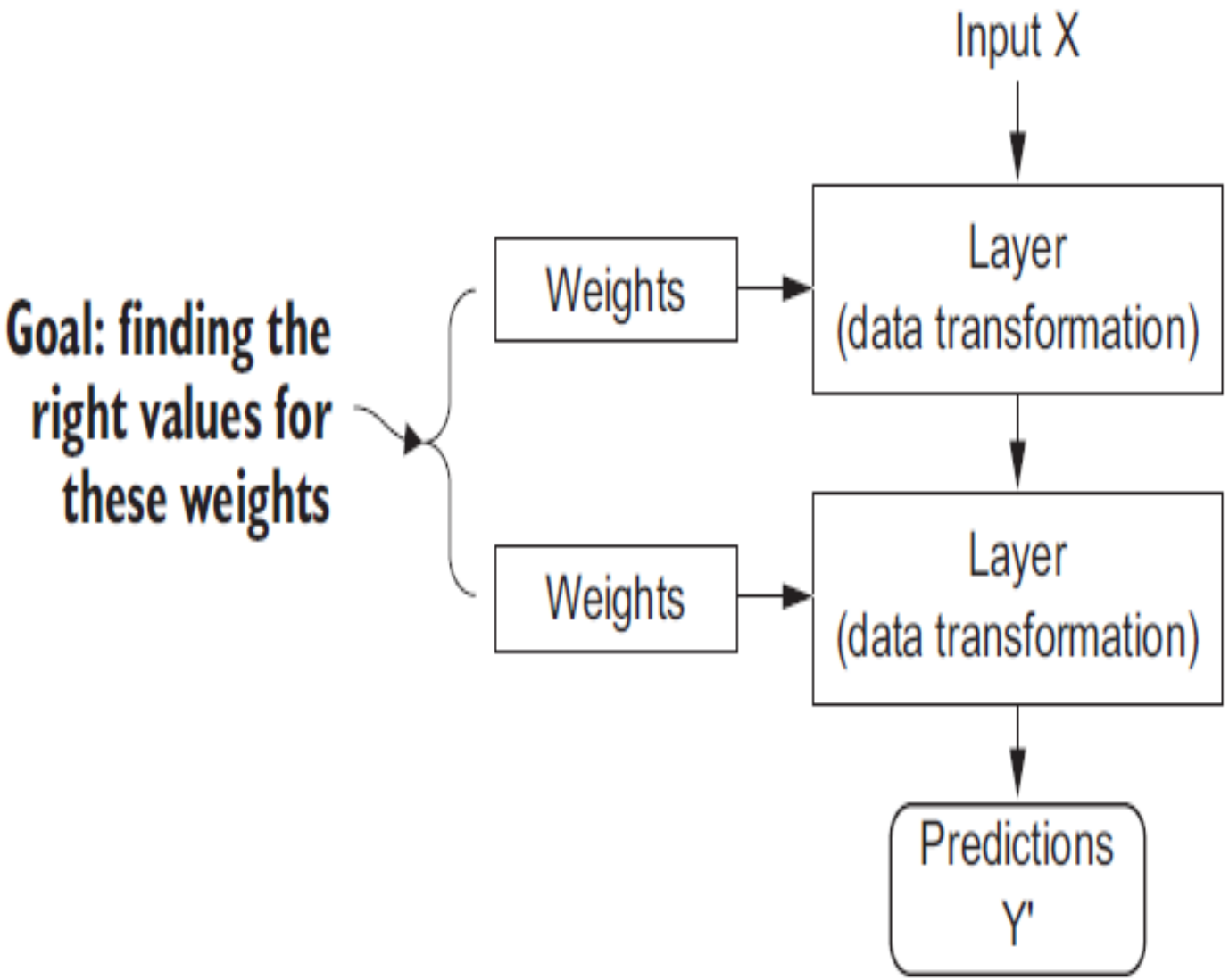

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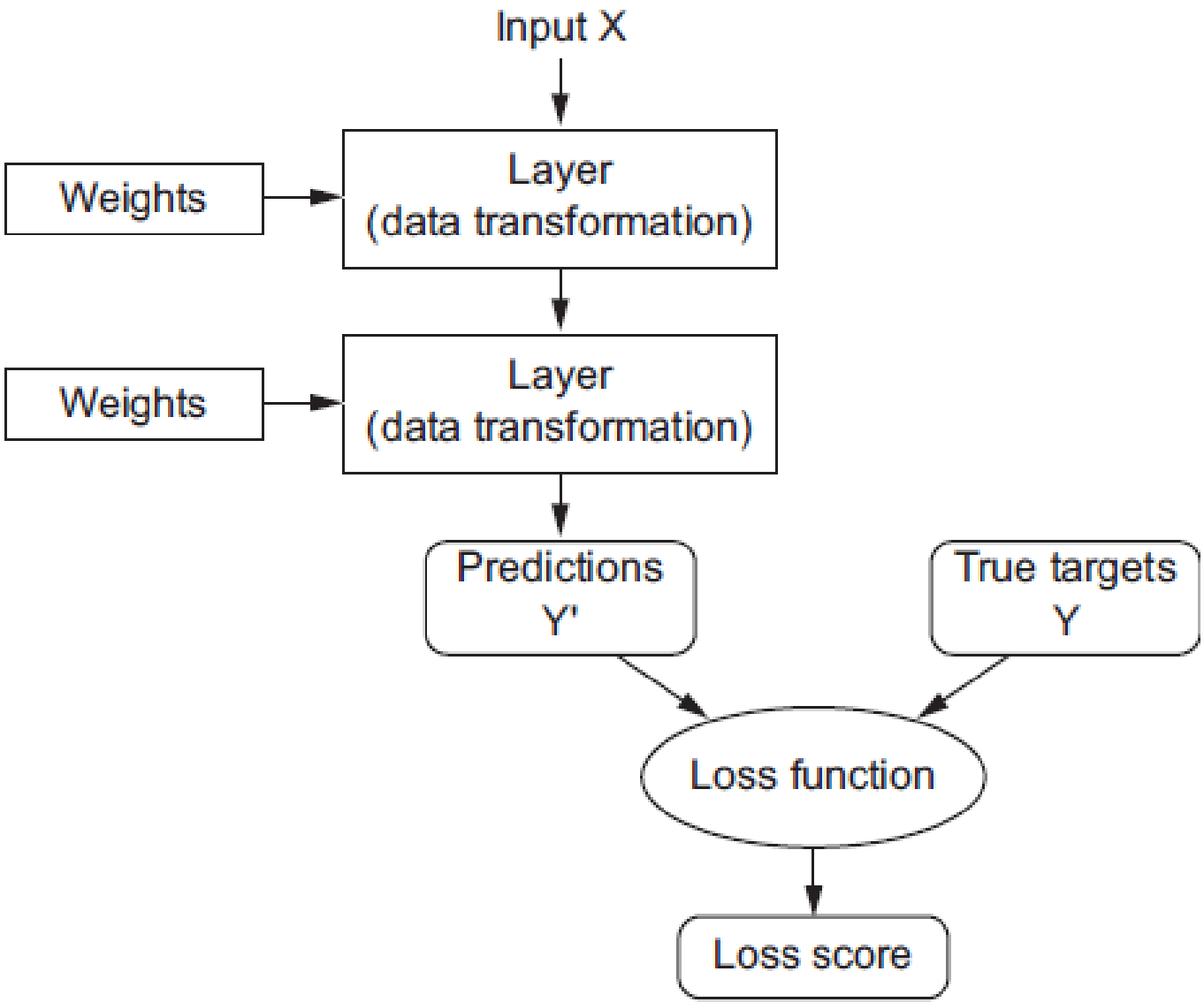

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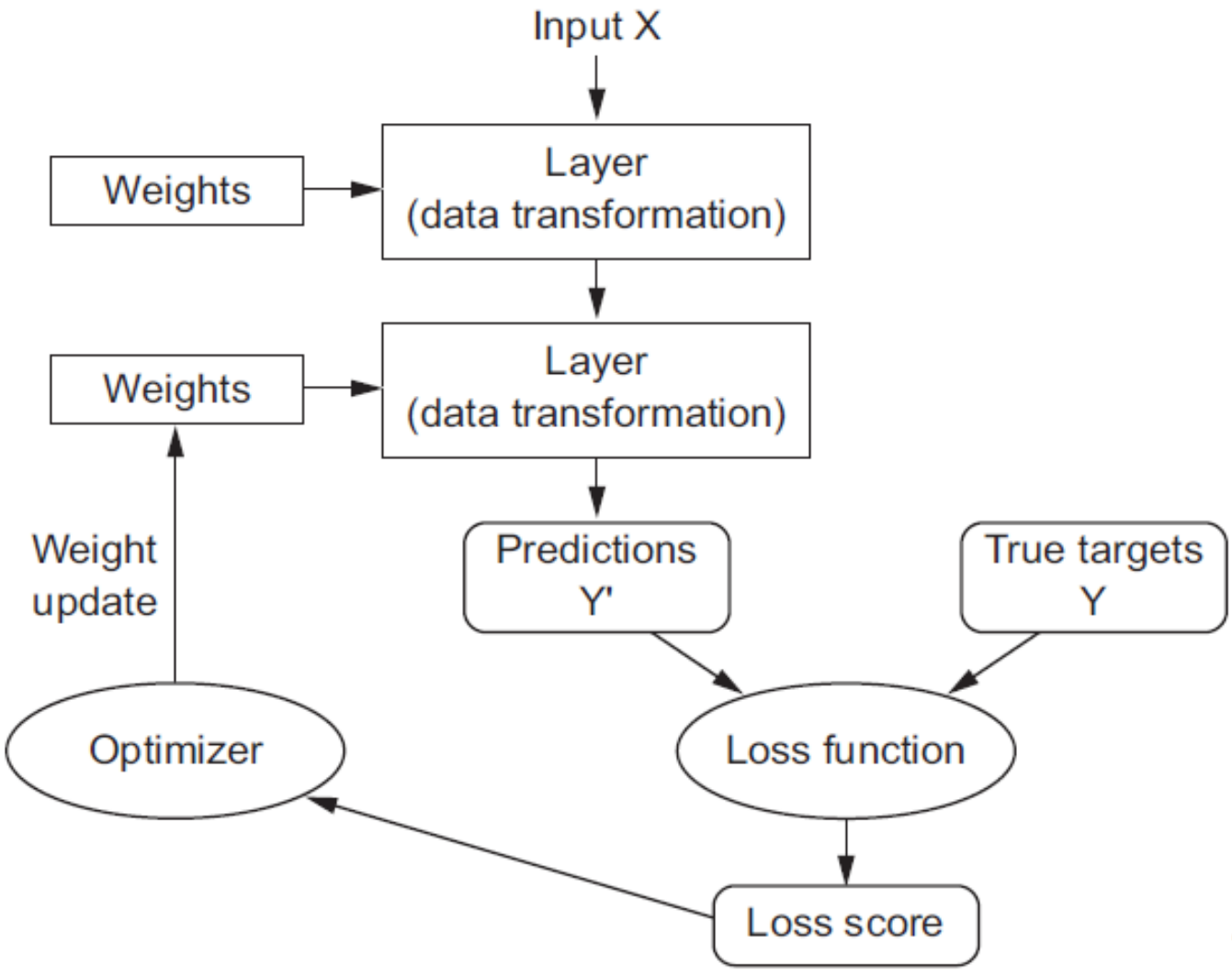

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A brief history

Deep learning isn't always the right tool for the job—sometimes there isn't enough data for deep learning to be applicable, and sometimes the problem is better solved by a different algorithm

Approach	algorithm	History
Probabilistic modeling	Naive Bayes logistic regression	The features in the input data are all independent
Early neural networks	LeNet	Emergence of SVM
Kernel methods	SVM	Hard to scale to large datasets
Decision trees	Decision trees, random forests, and gradient boosting machines	Weak prediction models

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Back to neural networks

- ImageNet

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- Intermediate incremental representations are learned jointly

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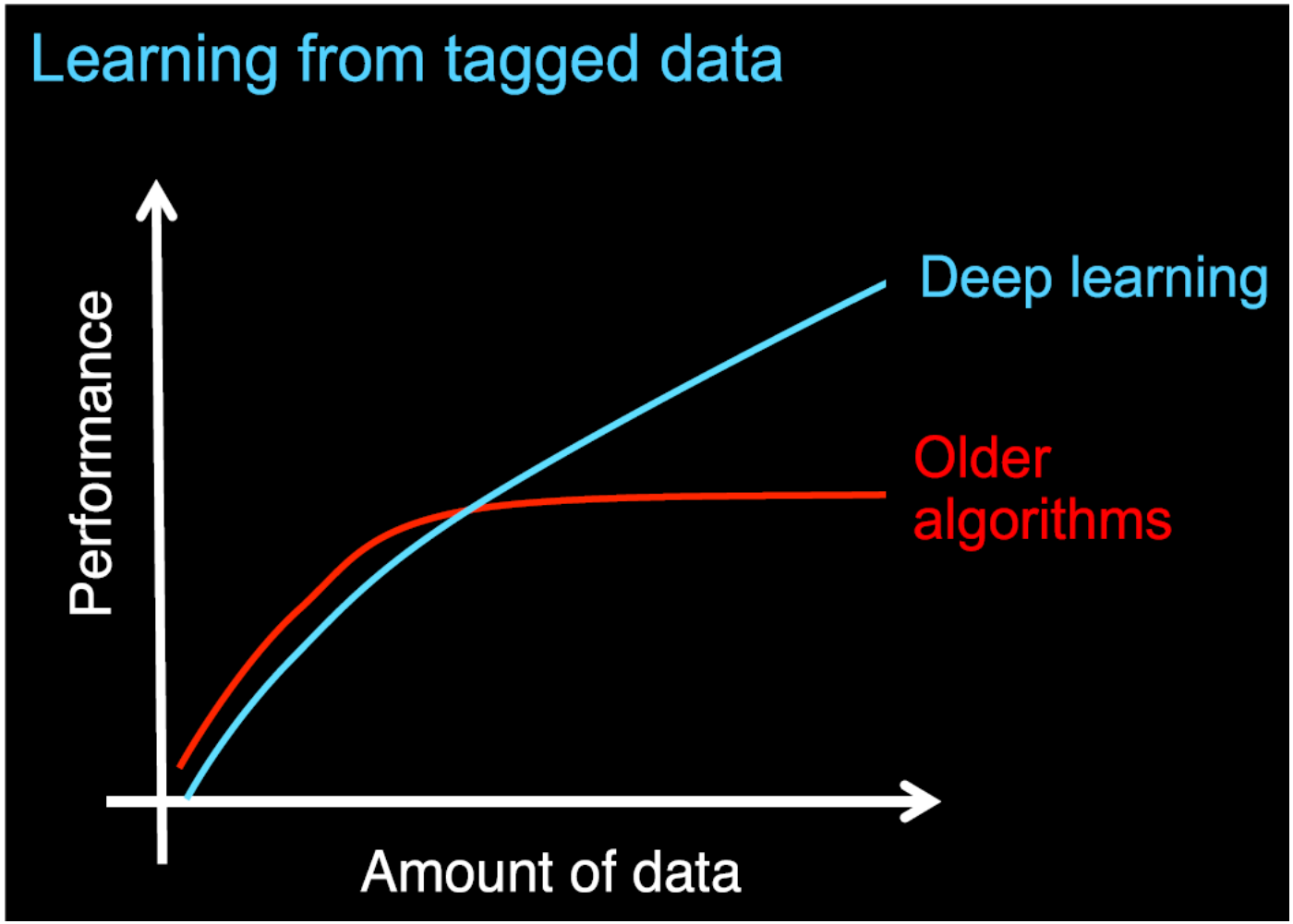

(http://cs229.stanford.edu/materials/CS229-DeepLearning.pdf)

Back to neural networks

- Near-human-level image classification
- Near-human-level speech recognition
- Near-human-level handwriting transcription
- Improved machine translation
- Improved text-to-speech conversion
- Digital assistants such as Google Now and Amazon Alexa
- Near-human-level autonomous driving
- Improved ad targeting, as used by Google, Baidu, and Bing
- Improved search results on the web
- Ability to answer natural-language questions

Back to neural networks

KAGGLE

Kaggle was dominated by two approaches: gradient boosting machines and deep learning. Specifically, gradient boosting is used for problems where structured data is available, whereas deep learning is used for perceptual problems such as image classification. Practitioners of the former almost always use the excellent XGBoost library, which offers support for the two most popular languages of data science: Python and R. Meanwhile, most of the Kaggle entrants using deep learning use the Keras library, due to its ease of use, flexibility, and support of Python.

Bibliography

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