Deep Learning

Arbeitsbericht
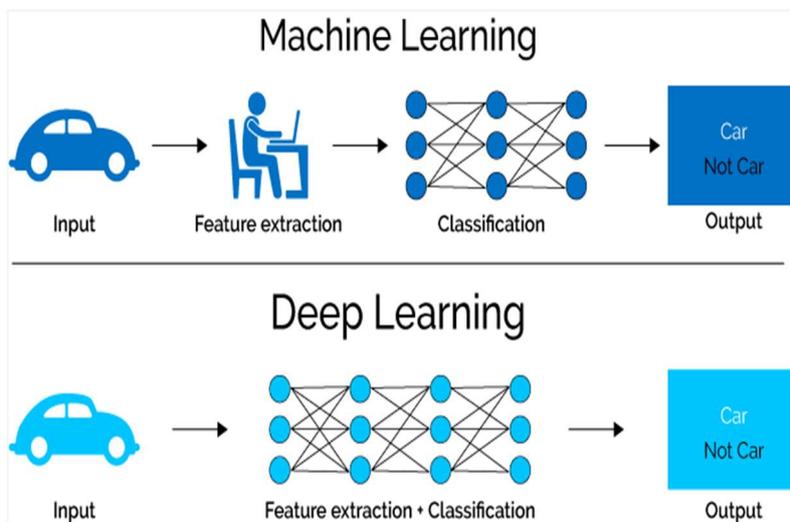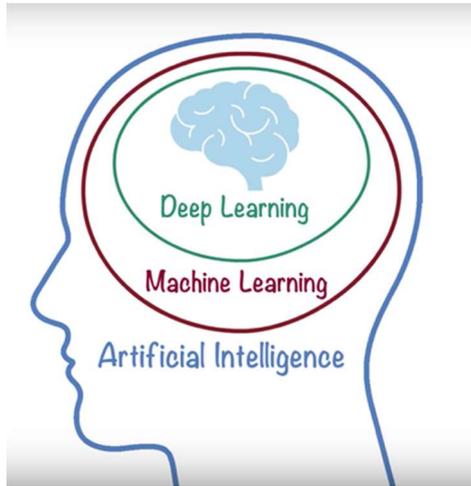
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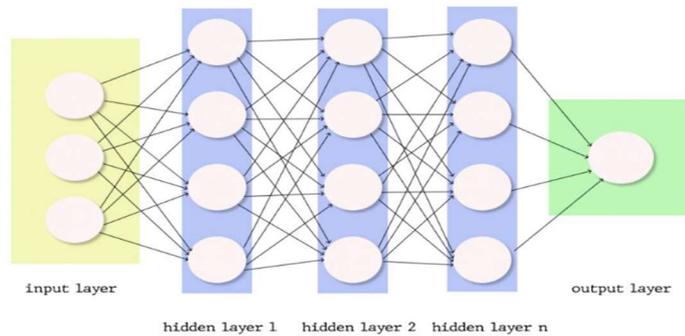Deep Learning
Machine Learning
Artificial Intelligence

Machine Learning

Input — Feature extraction — Classification — Output (Car / Not Car)

Deep Learning

Input — Feature extraction + Classification — Output (Car / Not Car)

neural network

input layer — hidden layer 1 — hidden layer 2 — hidden layer n — output layer

Definition & Relevance

Deep Learning (DL) is one of the ways of implementing Machine Learning (ML) through artificial neural networks (ANNs) algorithms [11]. The concept of ANNs is simple: to replicate the processing methodology of the human brain which is composed of connected network of neurons [1, 9]. A brief history of DL can also be read here.

Deep Learning – How it works?

The evolution of digital era brought an explosion of data in all forms. However, this data is normally unstructured, is so vast that it could take decades for humans to comprehend and extract relevant information [13]. So in order to process and understand this data, DL uses neural network architecture to progressively extract high level features from the raw data and automatically learn representations from data such as images, video or text. The Neural Network is constructed from 3 type of layers [12]:

1. Input layer — initial data for the neural network.

2. Hidden layers — intermediate layer between input and output layer and place where all the computation is done.

3. Output layer — produce the result for given inputs.

Detail structure on how DL works can be read here

Deep learning vs Machine Learning:

According to [14] ANNs outperforms machine learning algorithms such as Decision Tree, Linear Regression and KNN etc. provided large amount of training data. But when it comes to interpretability (to know why a particular prediction was made by a machine) Decision trees are better than NN. In a research conducted in identifying syndromes in Coronary Heart Disease NN has provided highest accuracy compared to classic ML algorithms [14].

Advantages of Deep Learning [2, 3]

Data dependencies: DL models tend to perform well with increasing amounts of data, whereas other ML models stop improving after a saturation point. Therefore, see the following figure.
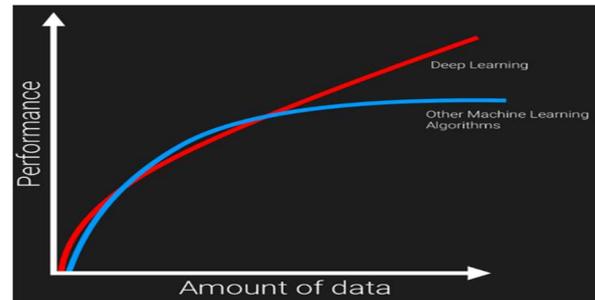
Feature engineering [8]: In ML, most of the applied data features need to be identified by a human and is then hand coded as per the domain and data type. On other hand, DL algorithms try to learn high-level features from data automatically. It does not require human intervention – see the second figure on the front page.

Application and Use Cases [4, 5]

DL applications are used in several industries such as automotive, medical, and aerospace and defense, industrial automation, electronics etc. For example, cancer researchers use DL in order to automatically recognize cancer cells. Teams at UCLA [10] have built an innovative microscope that provides a high-dimensional data set that can be used to train a DL application to identify cancer cells. This is important because tumors can develop in diverse ways. DL is used to classify this complexity. Other use cases include Object detection, Sentiment analysis, and Text translation to name a few.

Conclusion [6]

In the current state of DL, it can mimic an infant's brain. It will take some years for the

web of neural networks in it to mature and infer like grown-up humans. But with the development of new neural network architecture's like GAN, Siamese Network, OpenAI's GPT-2 Model, we are getting closer towards building DL models which can mimic the complex functionalities of specific parts of a mature human brain. Currently, work is focused on the integration of deep learning into current solutions, as well as on software improvements to achieve a better match of input to output.

References

1. Machine Learning and Artificial Intelligence PP 117 - 126 https://www.springer.com/gp/book/9783030266219
2. https://medium.com/intro-to-artificial-intelligence/deep-learning-series-1-intro-to-deep-learning-abb1780ee20
3. https://www.xenonstack.com/blog/log-analytics-deep-machine-learning/
4. https://www.mathworks.com/discovery/deep-learning.html
5. https://towardsdatascience.com/deep-learning-vs-machine-learning-e0a9cb2f288
6. https://medium.com/towards-artificial-intelligence/deep-learning-past-present-and-future-b6316253cad8
7. https://towardsdatascience.com/types-of-machine-learning-algorithms-you-should-know-953a08248861
8. https://www.analyticsvidhya.com/blog/2017/04/comparison-between-deep-learning-machine-learning/
9. https://towardsdatascience.com/the-differences-between-artificial-and-biological-neural-networks-a8b46db828b7
10. https://cnsi.ucla.edu/blog/2016/04/13/microscope-uses-artificial-intelligence-to-find-cancer-cells-more-efficiently/
11. https://blog.soshace.com/deep-learning-vs-machine-learning-overview-comparison/
12. https://towardsdatascience.com/everything-you-need-to-know-about-neural-networks-and-backpropagation-machine-learning-made-easy-e5285bc2be3a
13. https://www.investopedia.com/terms/d/deep-learning.asp
14. https://link.springer.com/chapter/10.1007/978-3-540-72383-7_148

Further links:

15. https://www.youtube.com/watch?v=aircAruvnKk&t=324s

Ihr Ansprechpartner

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