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Data science

From Wikipedia, the free encyclopedia

(Redirected from [Data Science](#))

Not to be confused with [information science](#).

! **Data science** is an [inter-disciplinary](#) field that uses scientific methods, processes, algorithms and systems to extract [knowledge](#) and insights from many structural and [unstructured data](#).^{[1][2]} Data science is related to [data mining](#), [machine learning](#) and [big data](#).

! Data science is a "concept to unify [statistics](#), [data analysis](#) and their related methods" in order to "understand and analyze actual phenomena" with data.^[3] It uses techniques and theories drawn from many fields within the context of [mathematics](#), [statistics](#), [computer science](#), [domain knowledge](#) and [information science](#). Turing award winner Jim Gray imagined data science as a "fourth paradigm" of science ([empirical](#), [theoretical](#), [computational](#) and now [data-driven](#)) and asserted that "everything about science is changing because of the impact of information technology" and the [data deluge](#).^{[4][5]}

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 - 1.1 Relationship to statistics
- 2 Etymology
 - 2.1 Early usage
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- 3 Careers in data science
 - 3.1 Educational path
 - 3.2 Specializations and associated careers
- 4 Impacts of data science
- 5 Technologies and techniques

Part of a series on
Machine learning
and
data mining !

Problems

[show]

Supervised learning
([classification](#) • [regression](#))

[show]

Clustering

[show]

Dimensionality reduction

[show]

Structured prediction

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Anomaly detection

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8 Machine Learning III

- Specialized Areas in Machine Learning

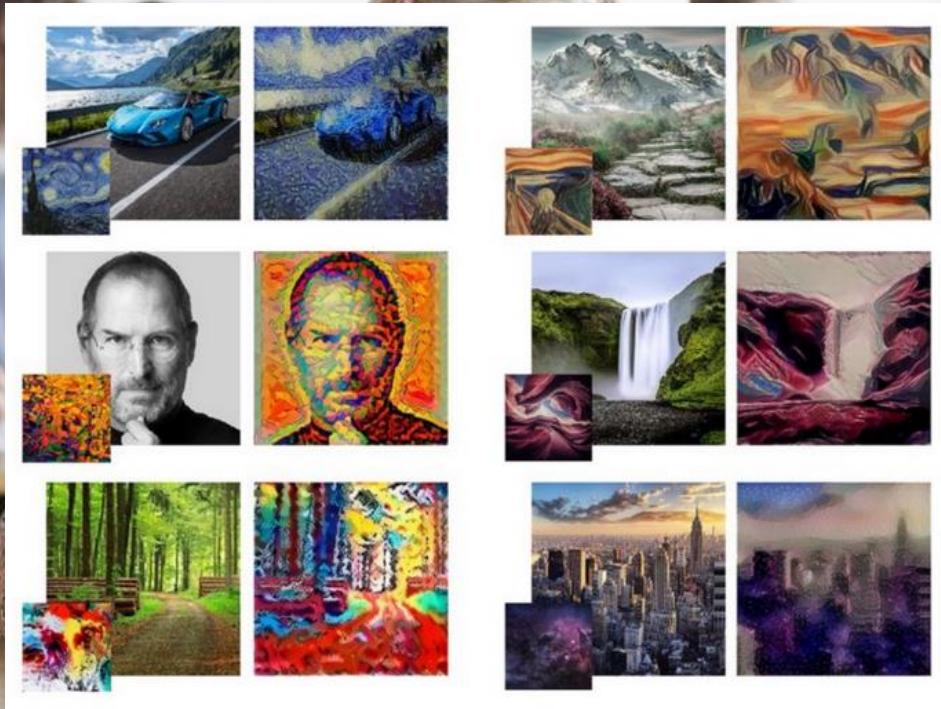
Content:

1. Transfer Learning & Teachable Machine
2. YOLO & Real-Time Object Detection
3. Autoencoder & Super Sampling
4. Generative Adversarial Networks (GAN)
5. Reinforcement Learning
6. The Human Role in Machine Learning **Live**
7. Summary



Which machine learning technique is used in this case (and in Deepfakes)?

Schwierigkeitsgrad	Art des Wissens Abfragewissen (Vorlesung)	Anwendungswissen (Literatur)
Einfach	Green	Yellow
Mittel	Yellow	Red
Schwierig	Red	Red



- a) Convolutional Neural Networks
- b) Transfer Learning
- c) Generative Adversarial Networks
- d) Reinforcement Learning
- e) Transformer

Fill in the Blank.

Schwierigkeitsgrad	Art des Wissens	Abfragewissen (Vorlesung)	Anwendungswissen (Literatur)
Einfach			
Mittel			
Schwierig			

1 is an area of machine learning concerned
with how intelligent agents ought to take actions in 2 in order to
3 the notion of cumulative 4

1 is one of three basic Machine Learning Paradigms,
alongside Supervised Learning and Unsupervised Learning. (Wikipedia)

- a) Reinforcement learning | environment | maximize | mistakes
- b) Reinforcement learning | environment | minimize | rewards
- c) Reinforcement learning | process | generate | loss
- d) Reinforcement learning | process | minimize | loss
- e) Reinforcement learning | environment | maximize | rewards

Google's Artificial Intelligence Built an AI That Outperforms Any Made by Humans

It's more accurate and more efficient than any other system.

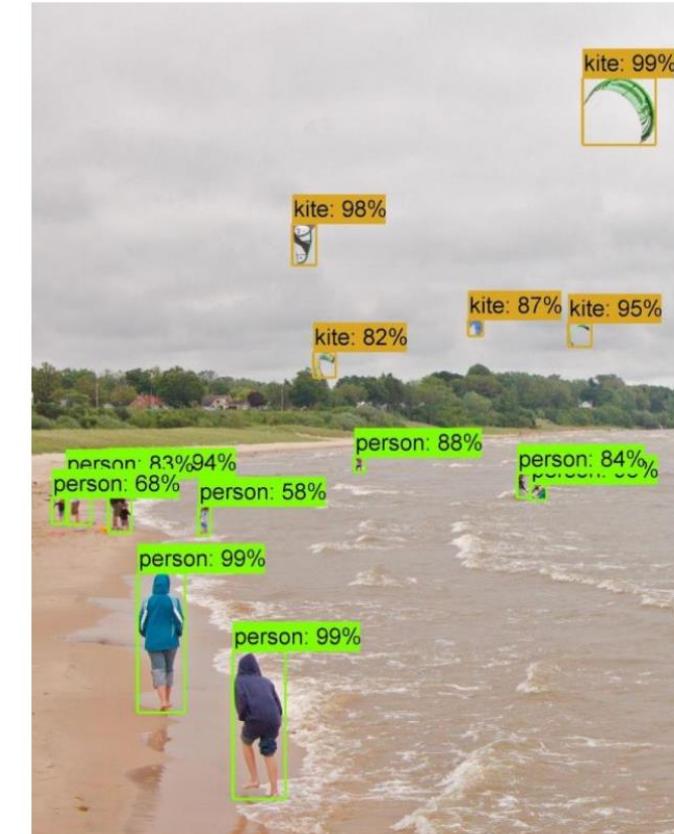
DOM GALEON | DECEMBER 1ST 2017

An AI That Can Build AI

In May 2017, researchers at [Google Brain](#) announced the creation of [AutoML](#), an artificial intelligence (AI) that's capable of generating its own AIs. More recently, they decided to present AutoML with its biggest challenge to date, and the AI that can build AI created a "child" that outperformed all of its human-made counterparts.

The Google researchers [automated the design of machine learning models](#) using an approach called [reinforcement learning](#). AutoML acts as a controller neural network that develops a child AI network for a specific task. For this particular child AI, which the researchers called NASNet, the task was recognizing objects — people, cars, traffic lights, handbags, backpacks, etc. — in a video in real-time.

According to the researchers, NASNet was 82.7 percent accurate at predicting images on ImageNet's validation set. This is 1.2 percent better than any [previously published results](#), and the system is also 4 percent more efficient, with a 43.1 percent mean Average Precision (mAP). Additionally, a less computationally demanding version of NASNet outperformed the best similarly sized models for mobile platforms by 3.1 percent.



Which statement about Transfer Learning is FALSE?

Schwierigkeitsgrad	Art des Wissens	Abfragewissen (Vorlesung)	Anwendungswissen (Literatur)
Einfach		Green	Yellow
Mittel		Yellow	Red
Schwierig		Red	Red

- a) Learning of a new **task relies on the previous learned tasks.**
- b) Learning **reuses abstract knowledge, retrains specific knowledge.**
- c) Learning is **initialized from pre-trained weights and biases.**
- d) Learning **process can be faster at the cost of more training data.**
- e) It has the **potential to significantly improve the sample efficiency of a reinforcement learning agent.**

Michael Amberg

Todays Content:

1. Transfer Learning & Teachable Machine
2. YOLO & Real-Time Object Detection
3. Autoencoder & Super Sampling
4. Generative Adversarial Networks (GAN)
5. Reinforcement Learning
6. The Human Role in Machine Learning **Live**
7. Summary



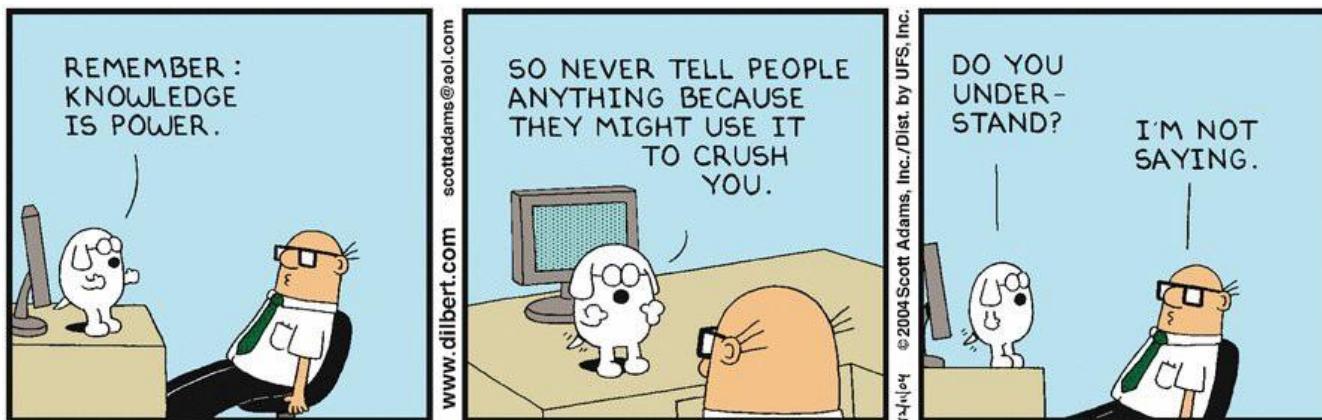
Transfer Learning

Transfer learning

From Wikipedia, the free encyclopedia

Transfer learning (TL) is a research problem in machine learning (ML) that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem.^[1] For example, knowledge gained while learning to recognize cars could apply when trying to recognize trucks.

This area of research bears some relation to the long history of psychological literature on [transfer of learning](#), although formal ties between the two fields are limited. From the practical standpoint, reusing or transferring information from previously learned tasks for the learning of new tasks has the potential to significantly improve the sample efficiency of a [reinforcement learning](#) agent.^[2]



5. (Deep) Reinforcement Learning



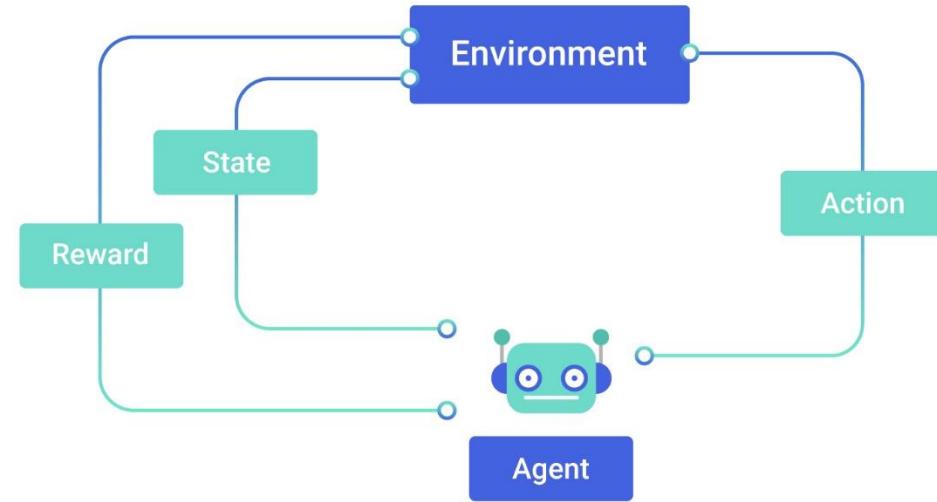
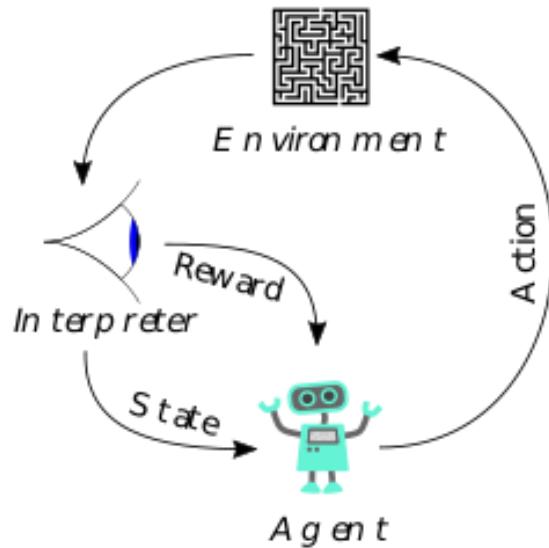
Playing Atari Breakout with Reinforcement Learning



Google DeepMind's Deep Q-learning playing Atari Breakout, 2015

www.youtube.com/watch?v=V1eYniJ0Rnk

Reinforcement Learning (RL)



Reinforcement Learning (RL) is an area of machine learning concerned with **how intelligent agents** ought to **take actions** in an **environment** in order to **maximize** the notion of cumulative **reward** (**learn from mistakes / experience**).

Reinforcement Learning is one of three basic Machine Learning Paradigms, alongside **Supervised Learning** and **Unsupervised Learning**. (Wikipedia)

Reinforcement Learning am Beispiel Laufen lernen

It might
look goofy ...



Google's DeepMind AI Just Taught Itself To Walk, 7/2017
<https://www.youtube.com/watch?v=gn4nRCC9TwQ>

Beispiel für Deep Reinforcement Learning: Multi-Agent Hide & Seek

Multi-Agent Hide and Seek

on earth the simple rules of natural

OpenAI: Multi-Agent Hide and Seek, 2019
www.youtube.com/watch?v=kopoLzvh5jY

Beispiel für Deep Reinforcement Learning:

Solving Rubik's Cube with a Robot Hand



Wikipedia zu DeepMind

DeepMind

From Wikipedia, the free encyclopedia

DeepMind Technologies Limited is a British artificial intelligence company founded in September 2010.

Acquired by Google in 2014, the company has created a neural network that learns how to play video games in a fashion similar to that of humans,^[4] as well as a Neural Turing machine,^[5] or a neural network that may be able to access an external memory like a conventional Turing machine, resulting in a computer that mimics the short-term memory of the human brain.^{[6][7]}

The company made headlines in 2016 after its AlphaGo program beat a human professional Go player for the first time in October 2015^[8] and again when AlphaGo beat Lee Sedol the world champion in a five-game match, which was the subject of a documentary film.^[9]

A more generic program, AlphaZero, beat the most powerful programs playing go, chess and shogi (Japanese chess) after a few hours of play against itself using reinforcement learning.^[10]

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- 2 Machine learning
 - 2.1 Deep reinforcement learning

DeepMind Technologies Limited



DeepMin

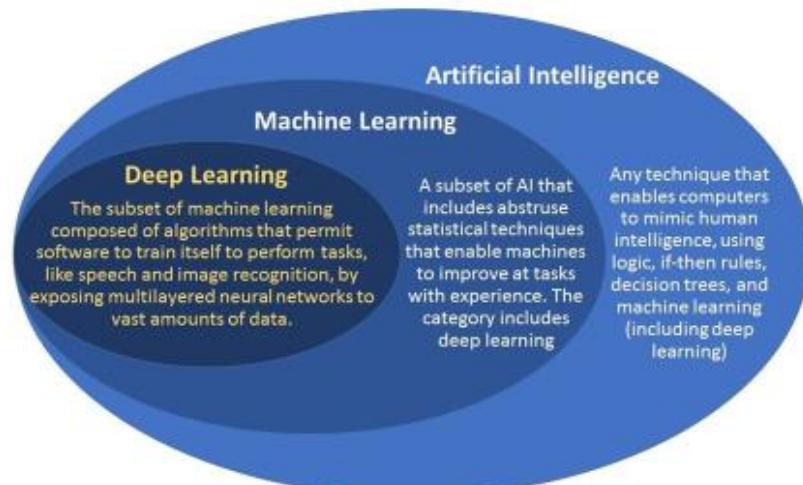
Type of business	Subsidiary
Founded	23 September 2010; 7 years ago ^[1]
Headquarters	6 Pancras Square, ^[2] London N1C 4AG, UK
Founder(s)	Demis Hassabis, Shane Legg, Mustafa Suleyman
CEO	Demis Hassabis
Industry	Artificial Intelligence
Employees	400 ^[3]
Parent	Independent (2010–2014) Google Inc. (2014–present) Alphabet Inc. (2015–present)
Website	www.deepmind.com

8 Machine Learning I

- Neural Networks & Deep Learning

(1) Motivation & Intro Machine Learning

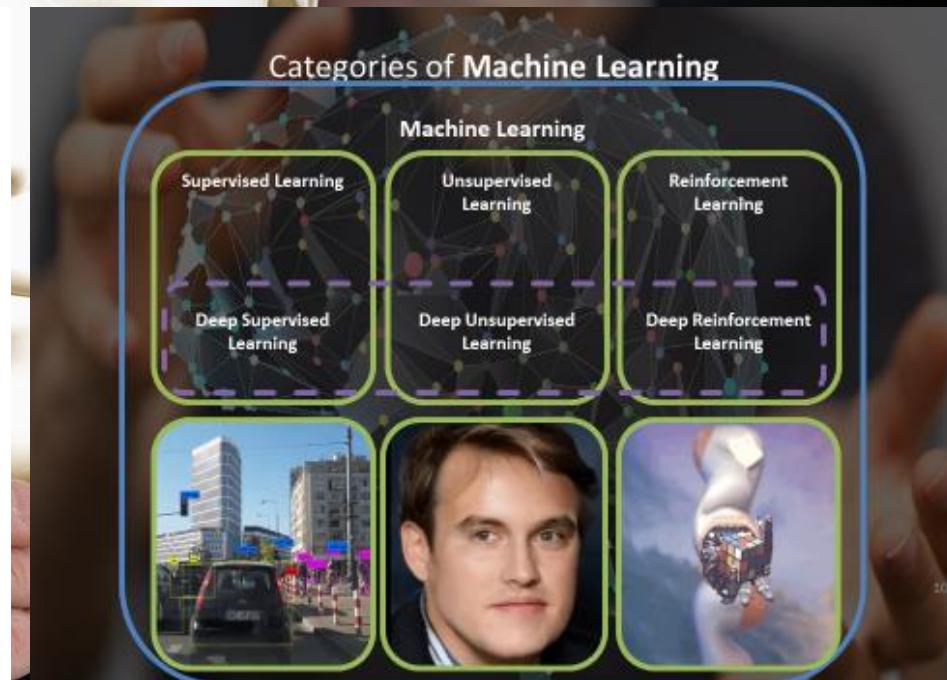
AI vs Machine Learning vs Deep Learning



What is the difference between AI, machine learning and deep learning?

www.geospatialworld.net/blogs/difference-between-ai-machine-learning-and-deep-learning/

Categories of Machine Learning





Machine learning

From Wikipedia, the free encyclopedia

Machine learning (ML) is the study of computer algorithms that improve automatically through experience.^[1] It is seen as a subset of **artificial intelligence**. Machine learning algorithms build a model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to do so.^[2] Machine learning algorithms are used in a wide variety of applications, such as **email filtering** and **computer vision**, where it is difficult or unfeasible to develop conventional algorithms to perform the needed tasks.

A subset of machine learning is closely related to **computational statistics**, which focuses on making predictions using computers; but not all machine learning is statistical learning. The study of **mathematical optimization** delivers methods, theory and application domains to the field of machine learning. Data mining is a related field of study, focusing on **exploratory data analysis** through unsupervised learning.^{[4][5]} In its application across business problems, machine learning is also referred to as **predictive analytics**.

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 - 1.1 Machine learning approaches
- 2 History and relationships to other fields
 - 2.1 Artificial intelligence
 - 2.2 Data mining
 - 2.3 Optimization
 - 2.4 Generalization
 - 2.5 Statistics
- 3 Theory
- 4 Approaches
 - 4.1 Types of learning algorithms
 - 4.2 Models
 - 4.3 Training models
- 5 Applications

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**Machine learning
and
data mining**

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Deep learning

From Wikipedia, the free encyclopedia

Deep learning (also known as **deep structured learning**) is part of a broader family of machine learning methods based on artificial neural networks with representation learning. Learning can be supervised, semi-supervised or unsupervised.^{[1][2][3]}

Deep-learning architectures such as deep neural networks, deep belief networks, recurrent neural networks and convolutional neural networks have been applied to fields including computer vision, machine vision, speech recognition, natural language processing, audio recognition, social network filtering, machine translation, bioinformatics, drug design, medical image analysis, material inspection and board game programs, where they have produced results comparable to and in some cases surpassing human expert performance.^{[4][5][6]}

Artificial neural networks (ANNs) were inspired by information processing and distributed communication nodes in **biological systems**. ANNs have various differences from biological brains. Specifically, neural networks tend to be static and symbolic, while the biological brain of most living organisms is dynamic (plastic) and analog.^{[7][8][9]}

The adjective "deep" in deep learning comes from the use of multiple layers in the network. Early work showed that a linear **perceptron** cannot be a universal classifier, and then that a network with a nonpolynomial activation function with one hidden layer of unbounded width can on the other hand so be. Deep learning is a modern variation which is concerned with an unbounded number of layers of bounded size, which permits practical application and optimized implementation, while retaining theoretical universality under mild conditions. In deep learning the layers are also permitted to be heterogeneous and to deviate widely from biologically informed **connectionist** models, for the sake of efficiency, trainability and understandability, whence the "structured" part.

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(classification • regression)	
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Artificial intelligence

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Categories of Machine Learning

Machine Learning

Supervised Learning

Unsupervised
Learning

Reinforcement
Learning

Deep Supervised
Learning

Deep Unsupervised
Learning

Deep Reinforcement
Learning

