RESEARCH REVIEW JOURNALS
Volume-03
Issue-11
November -2018

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com [UGC Listed Journal]

Theoretical concept of Machine Learning and Deep Learning in Artificial intelligence

[1]Rupen Chatterjee and [2]Dr. Molly Dutta Gupta

[1]Department of Mathematics, Nabagram Hiralal Paul College, Nabagram, Hooghly, West Bengal , Pin:712246, India (Affiliated to Calcutta University)
[2]Department of Physics, Nabagram Hiralal Paul College, Nabagram, Hooghly, West Bengal, Pin:712246, India (Affiliated to Calcutta University)

ARTICLE DETAILS

Article History
Published Online: 10 November 2018

Keywords
Artificial intelligence, Deep Learning, Machine Learning.

ABSTRACT

Artificial intelligence has been the most intriguing topic of 2018 according to McKinsey.AI became a catch-all term that refers to any computer program that automatically does something. Many people make referrals to AI without actually knowing what it really means. When autonomous agents interact in the same environment, they must often cooperate to achieve their goals. One way for agents to cooperate effectively is to form a team, make a binding agreement on a joint plan, and execute it. However, when agents are self-interested, the gains from team formation must be allocated appropriately to incentivize agreement. Various approaches for multi-agent negotiation have been proposed, but typically only work for particular negotiation protocols .There is public debate on whether it is an evil or savior for humanity. Thus this is yet another attempt to compile & explain the introductory AI/ML concepts to go beyond this buzz for non-practitioners and curious people. Artificial intelligence as an academic discipline was founded in 50s. Actually the “AI” term was coined by John McCarthy, an American computer scientist, back in 1956 at The Dartmouth Conference. According to John McCarthy, AI is “The science and engineering of making intelligent machines, especially intelligent computer programs”.

Though it was not until recently it became part of daily life thanks to advances in big data availability and affordable high computing power. AI works at its best by combining large amounts of data sets with fast, iterative processing and intelligent algorithms. This allows the AI software to learn automatically from patterns or features in that vast data sets. It is typical now we see AI news and examples on the mainstream news. Arguably the popularity milestone with public awareness was AlphaGo artificial intelligence program that ended humanity’s 2,500 years of supremacy in May 2017 at the ancient board game GO using a machine learning algorithm called “reinforcement learning”. Then these kinds of AI news become part of our daily digests with self-driving cars, Alexa/Siri like digital assistants frenzy, real time face recognition at airports, human genome projects, Amazon/Netflix algorithms, AI composers/artists, hand writing recognition, Email marketing algorithms and the list can go on and on. While Deep neural network, the most advanced form of AI, is at the top of the Gartner ’s 2018 hype cycle that is a sign of inflated expectations, self-driving cars have already made millions of miles with relatively satisfactory safety records. Artificial intelligence technologies will continue disrupting in 2019 and will become even more widely available due to affordable cloud computing and big data explosion. We do not recall any other tech domain right now that attracts so many smart people & vast resources from both the open source/maker community and the largest enterprises at the same time.

1. Introduction

Artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals. Leading AI textbooks define the field as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. Colloquially, the term "artificial intelligence" is often used to describe machines (or computers) that mimic "cognitive" functions that humans associate with the human mind, such as "learning" and "problem solving".

As machines become increasingly capable, tasks considered to require "intelligence" are often removed from the definition of AI, a phenomenon known as the AI effect. A quip in Tesler's Theorem says "AI is whatever hasn't been done yet." For instance, optical character recognition is frequently excluded from things considered to be AI, having become a routine technology. Modern machine capabilities generally classified as AI include successfully understanding human speech, competing at the highest level in strategic game systems (such as chess and Go), autonomously operating cars, intelligent routing in content delivery networks, and military simulations.

Artificial intelligence was founded as an academic discipline in 1955, and in the years since has experienced several waves of optimism, followed by disappointment and the loss of funding (known as an "AI winter"), followed by new approaches, success and renewed funding. For most of its history, AI research has been divided into sub-fields that often fail to communicate with each other. These sub-fields are based on technical considerations, such as particular goals (e.g. "robotics" or "machine learning"), the use of particular tools ("logic" or artificial neural networks), or deep philosophical

differences. Sub-fields have also been based on social factors (particular institutions or the work of particular researchers).

The traditional problems (or goals) of AI research include reasoning, knowledge representation, planning, learning, natural language processing, perception and the ability to move and manipulate objects. General intelligence is among the field's long-term goals. Approaches include statistical methods, computational intelligence, and traditional symbolic AI. Many tools are used in AI, including versions of search and mathematical optimization, artificial neural networks, and methods based on statistics, probability and economics. The AI field draws upon computer science, information engineering, mathematics, psychology, linguistics, philosophy, and many other fields.

The field was founded on the assumption that human intelligence"can be so precisely described that a machine can be made to simulate it".This raises philosophical arguments about the mind and the ethics of creating artificial beings endowed with human-like intelligence. These issues have been explored by myth, fiction and philosophy since antiquity. Some people also consider AI to be a danger to humanity if it progresses unabated. Others believe that AI, unlike previous technological revolutions, will create a risk of mass unemployment.

In the twenty-first century, AI techniques have experienced a resurgence following concurrent advances in computer power, large amounts of data, and theoretical understanding; and AI techniques have become an essential part of the technology industry, helping to solve many challenging problems in computer science, software engineering and operations research.

2. Fundamental Concepts of Machine Learning and Deep Learning in Artificial in Telliigence

So let's look at the definition of artificial intelligence, what is artificial intelligence, which is what we mean by AI. Artificial intelligence is a new technical discipline that researches and develops theories, methods, technologies, and application systems for simulating the extension and expansion of human intelligence. Our use of artificial intelligence research is to hope that machines can perform some complex tasks that require intelligent humans to complete. That is, we hope that the machine can replace us to solve some complicated tasks. In this process, it is not a repetitive mechanical activity, but some that require human wisdom to participate in it.

Machine Learning and Deep Learning

When it comes to artificial intelligence, we have to mention two aspects: machine learning and deep learning.

Machine Learning

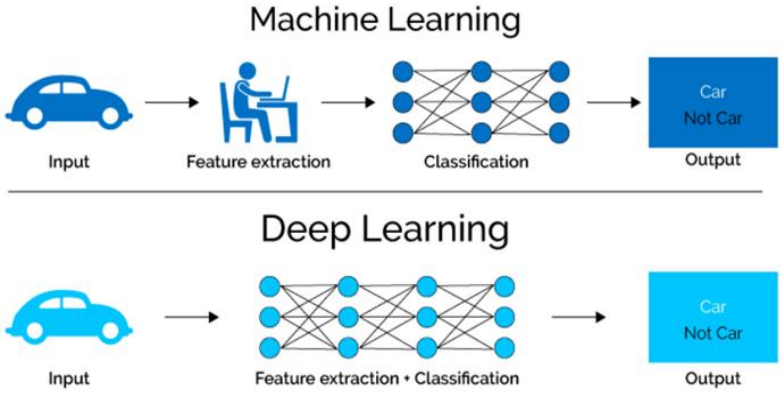
First of all, machine learning is a core concept in artificial intelligence. All of us have to learn, and our human knowledge transfer is also carried out through such a method of learning. We learn the knowledge of our ancestors, and then create new knowledge by inference. We also hope that the machine has such ability: By learning the previous information, the machine is more like having intelligence and can react accordingly for new input in the future. This is called machine learning.

Deep Learning

When we talk about artificial intelligence, we often hear concepts such as machine learning and deep learning. In fact, they are an inclusive relationship, and artificial intelligence includes machine learning and deep learning, and a specific form of learning in machine learning is called deep learning. It mainly based on algorithms of neural networks. At present, deep learning has made great progress in fields of image recognition, speech recognition, natural language processing, audio recognition, social network filtering, machine translation, medical image analysis, and board game programs.

While people often use these terms interchangeably, I think below is a good conceptual depiction to differentiate these 3 terms. AI is really a broad term and somewhat this also causes every company to claim their product has AI these days . Then ML is a subset of AI, and consists of the more advanced techniques and models that enable computers to figure things out from the data and deliver AI applications. ML is the science of getting computers to act without being explicitly programmed (Stanford University).

Finally, DL is a newer area of ML that that uses multi-layered artificial neural networks to deliver high accuracy in tasks such as object detection, speech recognition, language translation and other recent breakthroughs that you hear in the news. Beauty and strength of DL is they can automatically learn/extract/translate the features from data sets such as images, video or text, without introducing traditional hand-coded code or rules.



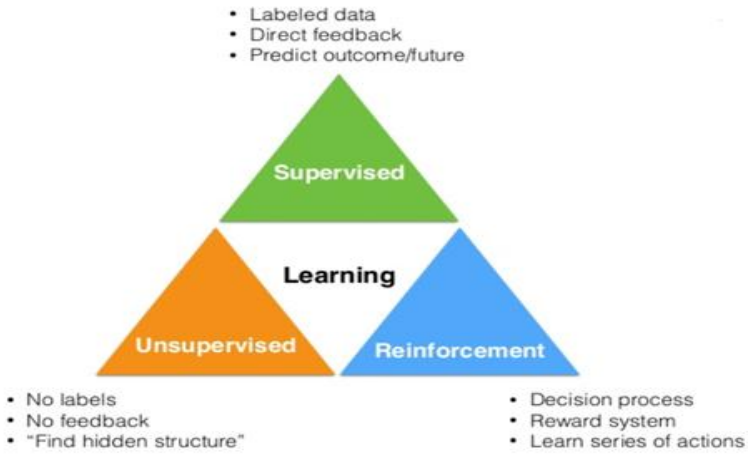
ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com [UGC Listed Journal]

In Machine Learning there are different models that generally fall into 3 different categories:

I)Supervised Learning, II)Unsupervised Learning and III) Reinforcement Learning.

I Supervised learning:

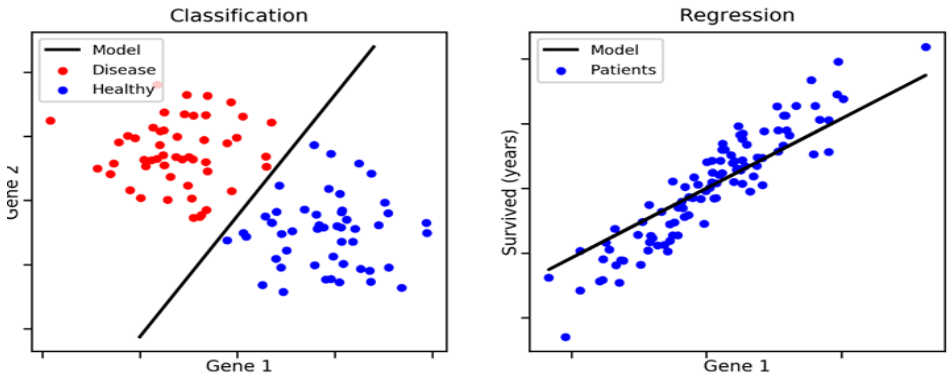
Involves an output label associated with each instance in the dataset. This output can be discrete/categorical or real-valued. Right now, almost all learning is supervised. The data has known labels as output. It involves a supervisor that is more knowledgeable than the neural network itself. For example, the supervisor feeds some example data about which the supervisor already knows the answers. The supervisor guides the system by tagging the output. For example, a supervised machine learning system that can learn which emails are 'spam' and which are 'not spam'. The algorithm would be first trained with available input data set (of zillions of emails) that is already tagged with this classification to help the machine learning system learn the characteristics or parameters of the 'spam' email and distinguish it from those of 'not spam' emails. Just as a three-year-old learns the difference between a 'block' and a 'soft toy', the supervised machine learning system learns which email is 'spam' and which is 'not spam'. Techniques such as linear or logistic **regressions** and decision tree **classification** fall under this category of learning.



Regression:

This is a type of problem where we need to predict and forecast for the continuous-response values. Some examples are what is the price of house in a specific city with 3 bedrooms and above 2,000 sqft. Predicting financial results, stock prices or how many total runs can be on board in a cricket game. There is an existing data set & outputs (supervised learning) and algorithm predicts the outcome based on a fitting function.

Classification: There is a need to categorize a certain observation into a group. In the below picture, ifthere isa given dot then it is need to classify it as either a blue dot or a red dot. Few more examples would be to predict if a given email is spam or not spam.Is a detected particle a Higgs Boson or a normal sub-atomic particle.Assigning a certain news article into a group like sports, weather, or science. Will it rain today or not. Is this picture a cat or not. Detecting fraud or evaluating risk for frauds or insurance under writing.



II Unsupervised Learning

This is an 'unaided' type learning when the data typically has no known output labels or any feedback loop. This is useful when there is no example data set with known answers and searching for a hidden pattern. In this case, clustering i.e. dividing a set of elements into groups according to some unknown pattern is carried out based on the existing data sets. The system has to understand itself from the data set we provide. In general, unsupervised learning is a bit difficult to implement and thus it's not used as widely as supervised learning. Most popular types are **clustering** and **association** as below.

Clustering

This is a type of unsupervised learning problem where we group similar things together. Some examples are: Given news articles or books, cluster them into different types of themes. Given a set of tweets, cluster them based on content of tweet. Could also be used for politics, health care, shopping, real estate etc.

III Reinforcement Learning (RL)

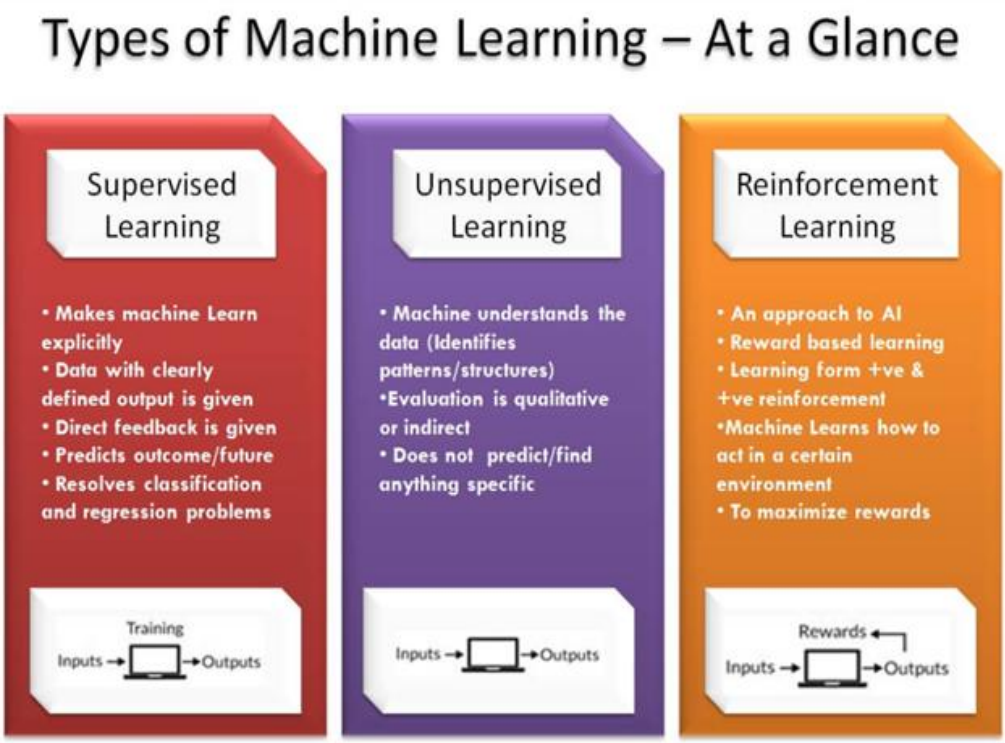
Now instead of telling the child which toy to put in which box, you reward the child with a 'big hug' when the child makes the right choice or make a 'sad face' when the child makes the wrong action. Very quickly after a few iterations the child learns which toys need to go into which box — this is called *Reinforcement Learning.* Systems are trained by receiving virtual "rewards" or "punishments", essentially learning by trial and error.

This strategy built on observation and trial & error to achieve goals or maximize reward. The agent makes a decision by observing its environment. If the observation is negative, the algorithm adjusts its weights to be able to make a different required decision the next time. One can count Reinforcement learning as part of the Deep learning as well based on hidden nodes and the complexity of algorithms. Reinforcement learning algorithms try to find the best ways to earn the greatest reward. Rewards can be winning a game, earning more money or beating other opponents.

Google DeepMind has used reinforcement learning to develop systems that can play games, including video games and board games such as GO. AlphaGo won a game with more board states than chess at 10 to the power of 170is greater than the number of atoms in the universe against a den 9 GO master. A combination of reinforcement learning and human-supervised learning was used to build "value" and "policy" neural networks that also used the search tree to execute its game play strategies. The software learned from 30 million moves played in human-on-human games.

Google DeepMind's researchers used reinforcement learning for training these AlphaStar agents. Agents play the game by trial and error while trying to reach certain goals like winning or simply staying alive. They learn first by copying human players and then play one another where strongest agents survive, and the weakest are discarded. DeepMind estimated that its AlphaStar agents each racked up about 200 years of game time in this way at an accelerated rate. RNN is taking humanity to the singularity point at least within the games context.

It may sound a bit overwhelming if come across the ML types first time but below is a visual summary to wrap up ML.



Deep Learning

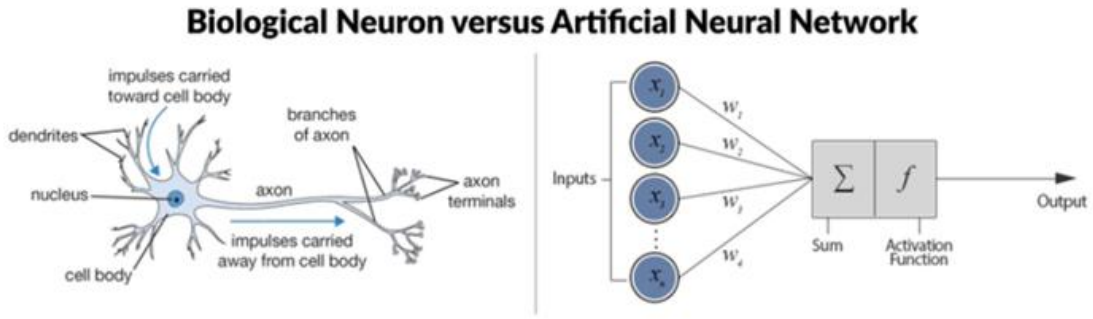
McKinsey claims that deep learning techniques have the potential to create between $3.5 trillion and $5.8 trillion in value annually in 19 industries.

Like ML, "Deep Learning" is also a method of statistical learning that extracts features or attributes from raw data sets. The main point of difference is DL does this by utilizing multi-layer artificial neural networks with many hidden layers stacked one after the other. DL also has somewhat more sophisticated algorithms and requires more powerful computational resources. These are specially designed computers with high performance CPUs or GPUs. They could be on premise ($) or as workloads on Cloud or still use laptop for prototyping.

Is deep learning inspired from human brain ? What are the Artificial Neural Networks?

How does a small child learn to recognize the difference between a school bus and a regular transit bus? How do we subconsciously perform complex pattern recognition tasks without even noticing? The answer is we have a biological neural network that is connected to our nervous systems. Our brains are very complex networks with about 10 billion neuron

each connected to 10 thousand other neurons.Each of these neurons receives electro-chemical signals and passes these messages to other neurons. Actually, we do not even well know how our brain neurons work. We do not know enough about neuroscience and the deeper functions of the brain to be able to correctly model how the brain works. DL is only inspired by the functionality of our brain cells called neurons which lead to the concept of artificial neural networks (ANN). ANN is modeled using layers of artificial neurons to receive input and apply an activation function along with a human set threshold. It may sound sci-fi to non-practitioners but DL is already in our daily lives. Deep learning has already achieved near or better than human level image classification, speech/hand writing recognition and of course the autonomous driving. Complex ad targeting or news feeds are all over when we surf the net.



In the most basic feed forward neural network (top right), there are five main components to artificial neurons. From left to right, these are:

1. Input nodes

Each input node is associated with a numerical value, which can be any real number. Example could be one pixel value of an image.

2. **Connections**

Similarly, each connection that departs from the input node has a weight (w) associated with it and this can be any real number. The ANN runs and propagates millions of times to optimize these "w" values. You need the high computational power to make this in short time.

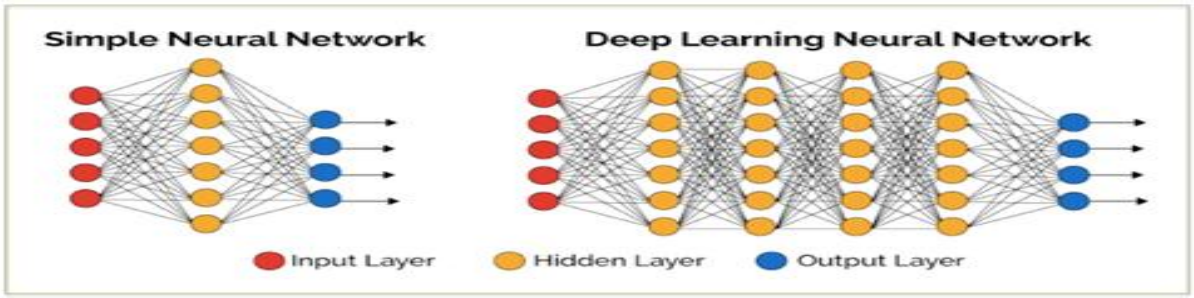
3. Next, all the values of the input nodes and weights of the connections are brought together. They are used as inputs for a **weighted sum**.

4. This result will be the input for a **transfer or activation function**. Just like a biological neuron only fires when a certain threshold is exceeded, the artificial neuron will also only fire when the sum of the inputs exceeds a threshold. These are parameters set by us (more on ethics later).

5. As a result, there is the**output node**, which is associated with the function of the weighted sum of the input nodes.

What is the "Deep" in deep learning?

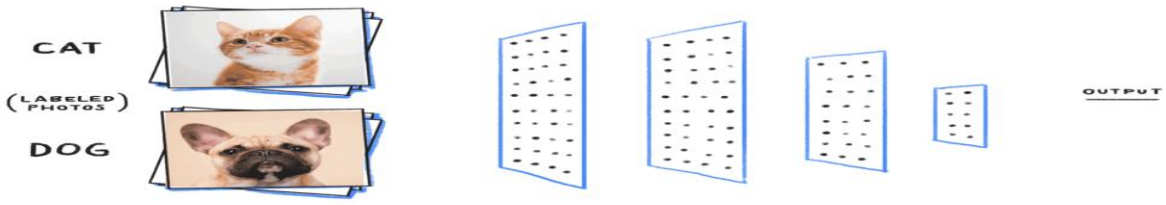
Deep-learning networks are distinguished from the more general single-hidden-layer neural networks by their **depth.** Depthis the number of node layers where there are more than one hidden layers thus need for more computation power for forward/backward optimization while training, testing and eventually running these ANNs.



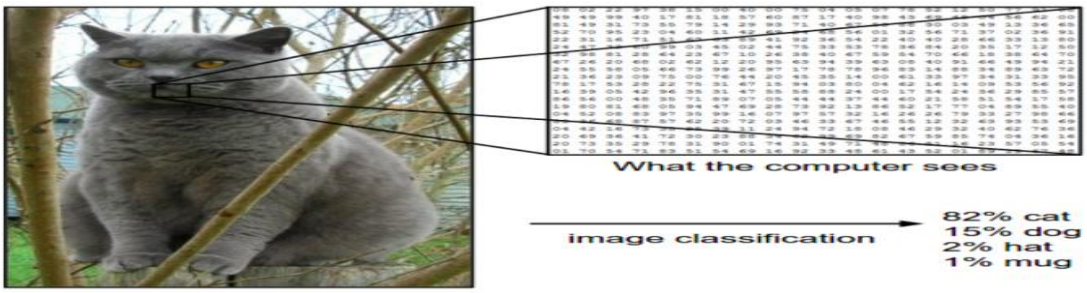
Among the layers, you can distinguish an input layer, hidden layers and an output layer. The layers act like the biological neurons. The outputs of one layer serve as the inputs for the next layer.

3. Methods and Analysis

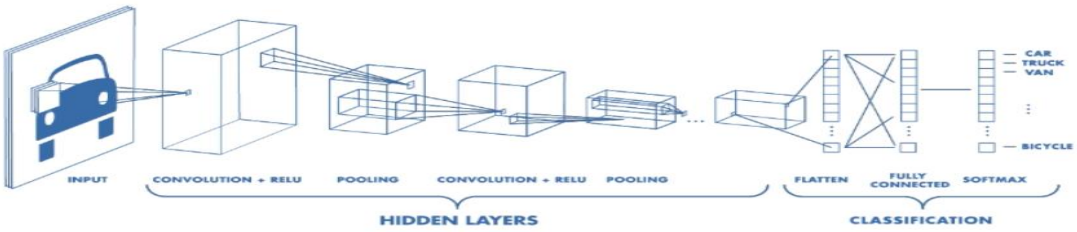
Convolutional neural networks (CNN): These are one of most popular applied DL cases. They are great for image/video processing or computer vision applications. CNNs are deep artificial neural networks that are used primarily to classify images (e.g. label what they see), cluster them by similarity (photo search), and perform object recognition within scenes. These are algorithms that can identify faces, individuals, street signs, tumors, flowers and many other aspects of visual data. Self driving cars or drones will increasing use CNN capabilities. The most popular applied corporate cases are probably optical character recognition (OCR) to digitize text to automate data entry.



The above example, our CNN algorithm sees the image differently vs. the human brain. Each image is a 3-dimensional arrays of numbers, known as pixels where you have width, height and depth. Width and height depends on the image resolution. The 3rd dimension (depth) is of the Red-Green-Blue (RGB) values for the color code .



Technically, deep learning CNN receives these images to pass through a series ofconvolution layers with filters (basic depiction below).



Of course initially these filters don't know where to look for image features like edges or curves and the previously mentioned weights are random numbers (like a baby with fresh mind). We typically have a large training data set with thousands of images with pre-identified labels. The model first makes a forward pass, calculates the initial weights, makes a prediction of the outcome label (i.e. this is a dog) and compares it with the truth that is the existing training set labels. Because this is a training set we already know the outcome labels thus depending on the success of the prediction, a **loss function** is calculated and the network makes a back pass while updating its weights. The way the computer is able to adjust its weights to decrease the loss is through a method called **back propagation**. Now the model performs a backward pass through the network, which is determining which weights contributed most to the loss and finding ways to fine tune these weights so that the loss decreases through consecutive passes.

Initially the calculated loss is expected to be very high and it is expected to decrease to a minimum after many (but fixed) times of forward/backward passes. At the end hopefully the network should be trained well enough so that the weights of the layers are tuned correctly. Then we run **testing** to be able to see whether our CNN model works. We should have a different set of images plus its respective labels and pass the testing set of images through the CNN. We compare the outputs to the testing set to see if and how well our network works. Naturally the more data, the better model could be tuned through training and testing. That 's why big data enables deep learning. After we have a good enough model, it is ready to be used for real life scenarios… while we continue tuning the model.

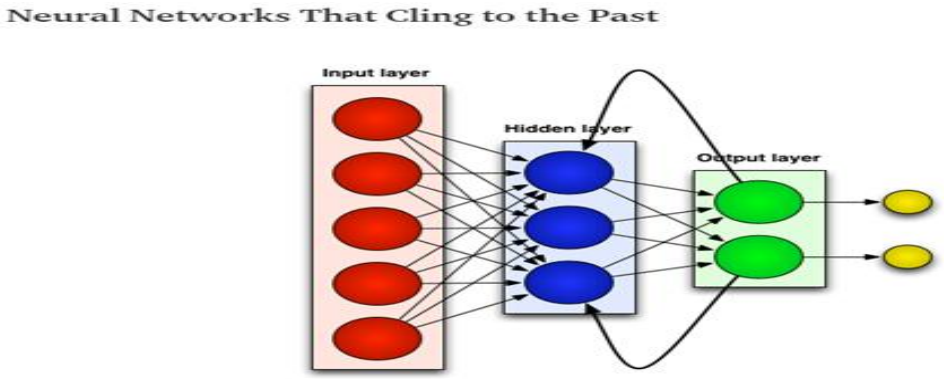
Obviously it is way more complex than this but this is the super high level & simplified logic for how most of the ANNs work for training and testing.

Another real-life example of computer vision is in action in China. Alibaba launched City Brain System in its birthplace in Hangzhou, China where an AI center optimizes the traffic controls.

CNN like algorithms already dominate our daily life: Facebook — automatic tagging, Google photo search, Pinterest home feed personalization. We are really looking forward the days CNN would help with treatments for the visually impaired.

Recursive (Recurrent) Neural Networks (RNN): Sometimes used interchangeably recursive neural network is just a generalization of a recurrent network while having the same acronym. An RNN simply uses previous input sources within the calculations. By analyzing handwriting, one can predict words and future letters much better than oneremember the previous letters. Another way to think about RNNs is that they have a "memory" which captures information about what

has been calculated so far. RNN can remember the former inputs, which gives them a big edge over other artificial neural networks when it comes to sequential and context-sensitive tasks such as speech recognition .

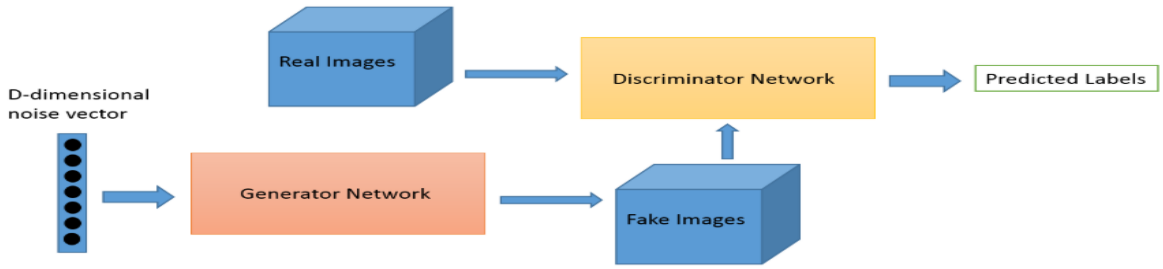


RNNs are considered maybe the most powerful model for NLP. RNNs are also used for language translations, composing music, writing novels, Wikipedia articles or Shakespearean poems, write AI tweet. One can train it to write machine generated Obama speeches or compose non-existent "Beatles" songs. Interesting huh Karpathy's blog, who is the current head of Tesla AI, has written one of most popular deep learning RNN articles to further refer to.

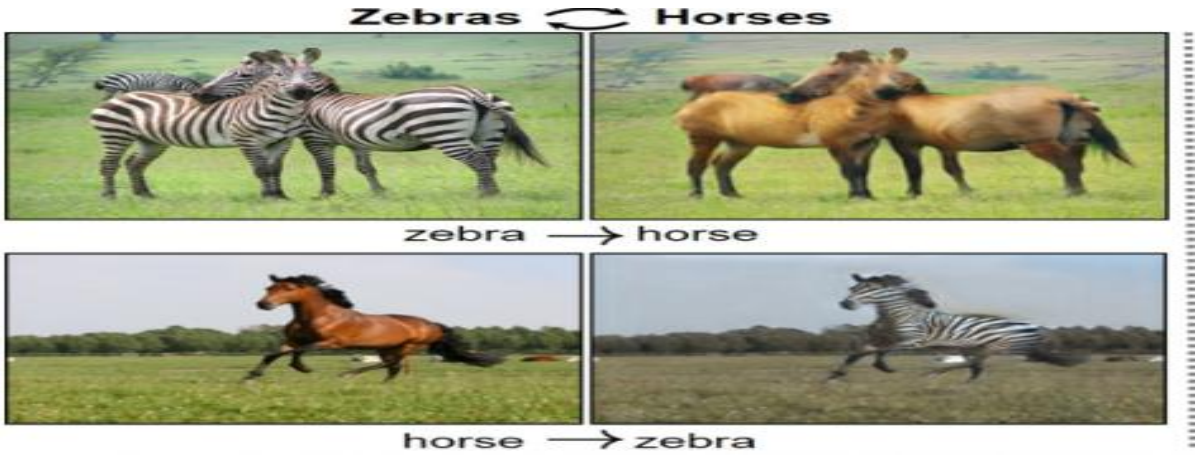
Generative Adversarial Networks (GAN): GANs were invented by Ian Goodfellow, who's now staff research scientist at Google Brain, and his associates from the University of Montreal in 2014. YannLeCun, the director of Facebook AI said: "Generative Adversarial Networks is the most interesting idea in the last ten years in Machine Learning." GAN makes the neural nets more human by allowing it to CREATE rather than just training it with data sets.

A generative adversarial network is composed of two neural networks: a **generative** network and a **discriminative** network. In the starting phase, a Generator model takes random noise signals as input and generates a random noisy (fake) image as the output. Gradually with the help of the Discriminator, it starts generating images of a particular class that look real.

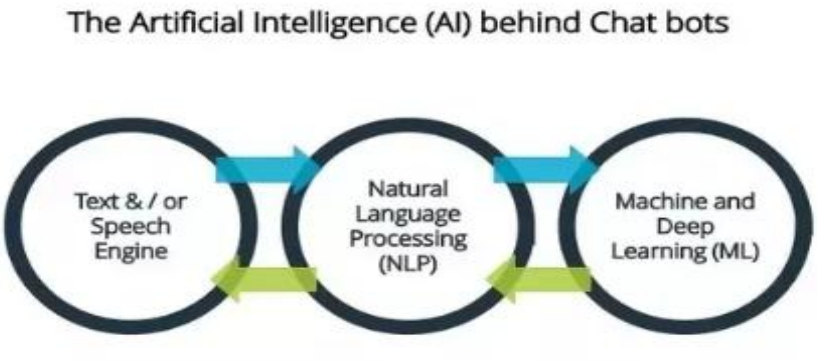
The Discriminator which is the advisory of Generator is fed with both the generated images as well as a certain class of images at the same time, allowing it to tell the generator how the real image looks like.



After reaching a certain point, the Discriminator will be unable to tell if the generate image is a real or a fake image, and that is when we can see images of a certain class (class that the discriminator is trained with) being generated by out Generator that never actually existed before! Experts sometimes describe this as the generative network trying to "fool" the discriminative network, which has to be trained to recognize particular sets of patterns and models.



Deep Learning for Natural Language Processing (NLP): ActuallyNLP is a broader topic though it gained huge popularity recently thanks to machine learning. NLP is the ability of computers to analyze, understand and generate human language, including speech. For example one can do sentiment analysis given any text. NLP can make AI recommendations after parsing thru movie/book reviews or web. NLP can run chatbots/digital assistants for front end tasks using text or audio interactions. Alexa/Siri/Cortana/Google Assistant are the famous digital personas using NLP engines.



The next stage of NLP is natural language interaction, which enables people to communicate with computers using everyday language to complete tasks. Google CEO, SundarPichaihad shown how the Google Assistant can make a few calls and book a haircut appointment. Other known used cases are *enterprise search or opinion mining (sentiment analysis)* . There is already a large choice of NLP engines that are readily available to embed into everyday uses whether it is call centers, chat-bots, translators, auto-predictors, spam filters or the new vast domain of digital assistants.

How to become a practitioner with machine learning?

(1) Learn some Python to get started and (2) experiment with Keras (or one of the other popular DL libraries below). (3) Take a practical real world problem and tackle it.

As the compiler/editor, it is prefer to use Jupyterexperiments though there are plenty of choice for alternative code editors. No need to be perfect from the get go. Be agile, fail fast & cheap, change course when needed and eventually one will get there.

Deep learning frameworks are changing rapidly. While the preference is Keras due to its user friendly API, TensorFlow is the current champion behind Google backing as below graph. Another heavyweight PyTorch has Facebook backing. CNTK is backed by Microsoft. Apache's MXnet is an easily scalable framework and backed by Amazon. Shortly, the landscape is very dynamic and will continue evolving. By installing the Anaconda package,it would suffice for initial needs and then one will continue installing other libraries as needed or further scale one can leverage one of the big cloud ML platforms like AWS SageMaker, Microsoft Azure AI, Google Cloud Platform ML&TensorFlow and other alternative players. Create an account using free credits to get started.

Finally there are many online resources and courses available. There is no all-included place but one can start with Medium articles, YouTube videos, AI Blogs, Stanford courses, online books or excellent courses on Coursera/Udemy/Datacamp programs.

Leading AI companies:

Nvidia and Intel produces the special microprocessors that greatly accelerate ML calculations. Google, Amazon, Microsoft and IBM (and many more companies) provide cloud infrastructure, ML services as well as higher level frameworks to accelerate the modeling, training and testing work. In 2019, almost every medium/large company would use ML or DL in their business. In other part of the world, most Chinese AI companies have ties to Baidu, Alibaba and Tencent. The competition is on.

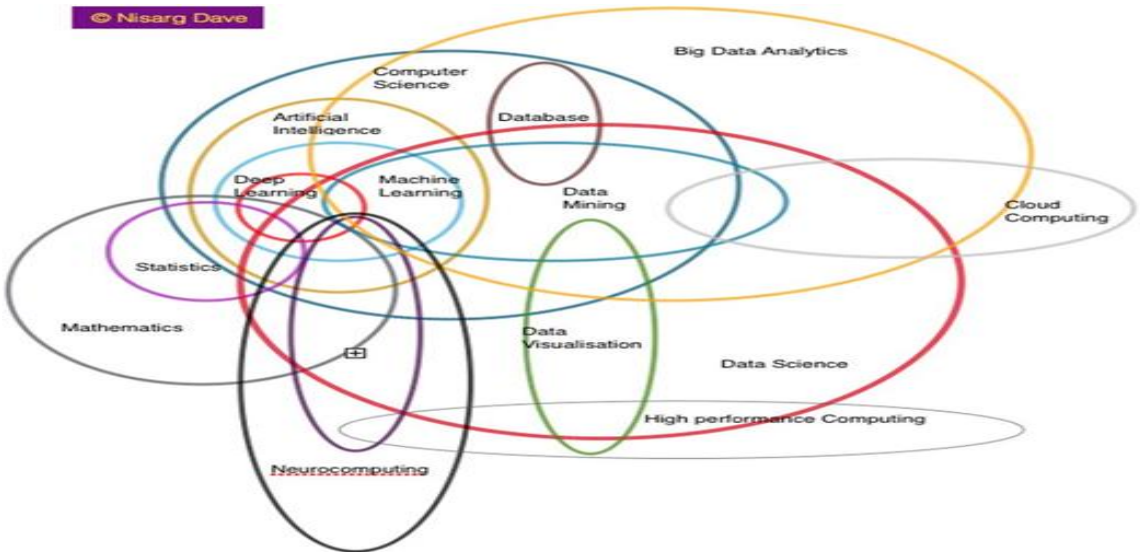
AI at work place - Intelligent process automation for the enterprise

This domain will exponentially grow behind all the AI capabilities we referenced earlier. We have only scratched the surface yet with replacing the repetitive & manual tasks with Robotic Process Automation(RPA). Next frontier is transforming and digitizing the E2E cognitive processes. Traditional RPA is now being combined with AI and other digital automation tools e.g., optical character recognition (OCR), workflow (Business Process Management), Chatbots (NLP), human-in-the-loop cognitive processing, virtual employees, auto ML. These will disrupt the workplace of the future and the whole business process outsourcing industry.

Intelligent process automation (IA) is an exponentially growing domain and quiet many players already.Recognized RPA players are Blueprism, UI Path, Automation Anywhere and Workfusion as well as many other up and coming start ups. Larger blue chip companies (IBM, SAP, SalesForce, Microsoft, Pega, Oracle, SAP) also started either offering or acquiring similar IA capabilities.

What is the difference between Data Science and Machine Learning?

Nisarg Dave 's image below does a great job of showing the interdisciplinary nature of data science and it is at the intersection of all these diverse fields. Data scientists need to have multi-disciplinary skills to be able to create a data set to test, create the code needed for the algorithms and deliver an innovative business insight.



AI and Ethics

Today AI doesn't have free will or consciousness but smart people do the learning before the ML models are deployed. While the core objective of AI is to augment humans, there is a lot of discussion around ethics of AI as well. Below are some other key topics to think and reflect.Microsoft CEO SatyaNadellasaid " We need to take accountability for the AI we create..."Will AI create unemployment? This is not a new fear. In the beginning AI will eliminate some of the human tasks though if we can find ways to adopt and re-skill ourselves then it has potential to create more jobs than it eliminates. This is maybe somewhat similar to transition from horses to cars during the first industrial revolution. Similar story when ATMs or computers came around in 70s and 80s.

Biased robots: Algorithms are programmed and designed by human thus this is an important topic to raise awareness, develop policies and maybe to regulate as a force for good. We should ensure our training sets, algorithms or parameters are not "biased" against the goal of the critical applications.

Security/Privacy: This is maybe the most discussed topic right now. We probably need better regulations and policies like GDPR in Europe. Inequality of AI capabilities: There is certainly a digital divide already with NA/EU and China dominating the AI world. There is opportunity to further democratize AI education across the world. We are more optimistic on this case given availability of free online information and open source work. Artificial errors and mistakes: Software glitches could easily cause AI mistakes.There needs to be clear accountability & regularity ownership.Who is responsible if a self-driving car or a drone makes a severe accident. Society needs to ensure that our complex AI systems do what we want them to do. Human interactions & cognitive skills: This is a real social impact and already happening. The more we leverage robots the interactions would go down and our dependence on AI will increase. Finally, the Singularity. We are probably still far away from a time when robots would overtake humans though it is worth considering this from now.

4. Application and Results

Weak and Strong Artificial Intelligence

Artificial intelligence has two different forms, one called weak artificial intelligence, and one called strong artificial intelligence.

Weak Artificial Intelligence

Weak artificial intelligencedefines that the machine is not really intelligent. The key is that it cannot have an autonomous consciousness. It can only have corresponding intelligence in a specific field, which is similar to a very advanced, a kind of bionics. Only in one aspect, such as watching, listening, and speaking, it appears to be intelligent, but it doesn't like humans who have complete consciousness.

Strong Artificial Intelligence

Strong artificial intelligence means that the machines can appear conscious and reach or even surpass human intelligence. This is not just a field of computer science, and it involves many aspects such as psychology, philosophy, and so on. It belongs to a kind of intelligence created by people, and can even be called life.

So the biggest difference between weak artificial intelligence and strong artificial intelligence is what intelligence level this machine can reach, and whether the machine has its own consciousness. This is the most essential difference between these two types of artificial intelligence. Don't afraid our world will be conquered by machines like Skynet or something else first. At present, the range of artificial intelligence we are studying is still in the range of weak artificial intelligence.

What is Neural Networks?

When it comes to artificial intelligence, we have to mention a well-known algorithm in artificial intelligence, called neural networks. Then the neural network is the same as the neural transmission of the human brain, from one input unit to the next input unit to get a result. This is the principle of a simple neural network, which is to simulate the transmission of information from nerves in the human brain. It transfers information from one neuron to another and then passes down

BP Neural Network

After the invention of the neural network algorithm, many problems have been solved to a certain extent. At the same time, people are constantly optimizing this algorithm. First, a very widely used and very classic one is the BP neural network. BP neural network has one more hidden layer than

the original neural network. There are additional hidden layers in the input layer and the output. It can greatly reduce the amount of calculation and the difficulty of calculation by way of gradient descent.

Convolutional Neural Network

But after we have the BP neural network, we find that the computational load of the BP neural network is still very large. It sometimes fails to give the optimal solution within our acceptable time range, or it takes too long to give the optimal solution, which does not meet the needs of some of our applications. Then came the convolutional neural network (CNN), which is also a kind of neural network algorithm in essence, but it optimizes the content in the BP neural network, it makes the calculation faster, and it can get the most on many problems. Excellent solution. It improves the efficiency of its calculation by processing related information highly concurrently. At the same time, it greatly reduces the computational complexity between BP neural networks. Therefore, the convolutional neural network can currently reach the optimal solution in a fast time on many problems.

Image Recognition

Image recognition is now widely used in our lives. For example, the identity of a person can be identified based on photos or when a person's face is captured with a camera. In many train stations in cities of China, one can swipe an ID card, the machine collects a face imagewith a camera, and then identify and verify identity. Some building access control uses image recognition for identification, and one no longer need an access card or a key. Other applications include advanced human-computer interaction, video surveillance, automatic indexing of images, and video database, among others.

Speech Recognition

Speech recognition provides a faster and more convenient way for us to interact with computers. When we speak to the computer, it can know what we are talking about and interact with us. This method is completely different from what we used to type on the keyboard. This way of interacting with the computer can bring us many extended applications. Virtual assistants like Siri, Google Assistant, Alexa can perform tasks or services for an individual based on commands or questions.

Self-Driving Car

Autonomous driving or self-driving car is also very popular in the field of artificial intelligence. Google's Waymo has already started a commercial self-driving car service called "Waymo One." Chinese Internet companies also successfully tested autonomous driving on the Fourth Ring Road in Beijing. Now there are also some advanced cars with modules for autonomous driving. With the emergence of 5G technology,it will revolutionize the way we travel in the future. C-V2X, the Cellular V2X (vehicle-to-everything), is a communication technology using the same 5G network. It allows vehicles to communicate with each other wirelessly and also with other transport infrastructures such as traffic lights, roadside, etc.

The Dynamic Purchasing System (DPS)

The Artificial Intelligence DPS is now open for applications. The Dynamic Purchasing System (DPS) marketplace provides access to all procurements run by the Crown Commercial Service opened, buyers can access framework agreements that meet common purchasing requirements across government.We would like to draw your attention to the Artificial Intelligence DPS, offering a simple route to purchase Artificial Intelligence services in the public sector. The government would like to put in place a collaborative agreement for the provision of Artificial Intelligence Services, the services offered under this DPS will support customers to scope the problem or project and help them understand how to solve problems using AI to maximise value and increase efficiency.

This agreement will use a Dynamic Purchasing System (DPS) to offer artificial intelligence (AI) services to the whole of the public sector and their associated bodies and agencies.

If you are new to AI you will be able to procure services through a discovery phase, to get an understanding of AI and how it can benefit your organisation. If you have experience in AI, you will be able to buy licensing, customisation and support directly from suppliers. If you would like both of these things, you will have access to end-to-end partnerships.

The type of technology available using the development, implementation and support of AI services includes AI software applications, machine learning to help with data analytics, intelligent virtual assistants and intelligent personal assistants.

Health and social care bodies will have access to AI applications such as medical imaging software, non-imaging diagnostic software and symptom-based software, to help accelerate AI technologies in health and social care in line with the AI in Health and Care Award.

Benefits

- Customer guidance and ordering processes align to government standards and guidelines, including the Data Ethics Framework and the Office for AI's Guidelines for AI Procurement.
- Promotes standards and criteria for AI and data-driven technology in healthcare.
- Addresses ethical considerations when innovating and buying AI and was designed to help customers build a strong ethics process.
- Bespoke terms have been added to support Intellectual Property Rights (IPR) in the AI market.
- Ensures the right suppliers can provide the right service offerings to reduce procurement timescales and provide an easier route to market for the type of AI.
- Quality, price and cultural fit (including social value) can be assessed based on individual customer requirements.

Consumer Finance

Imagine if we enter a sum of money we want to invest in on a web site, and like there is a financial planner around us, the AI will immediately tell us what kind of investment has the highest return. Artificial intelligence has made some great developments in finance areas.

5. Conclusion

Artificial intelligence is a very comprehensive discipline. It can do image recognition, speech recognition, auto-driving consumer finance, and so on. It is more and more human-like to listen, to see, to say, with these perceptions.To implement all of these, we have to know about machine learning and deep learning, which is the core content of artificial intelligence. That is to let the machine acquire certain intelligence through the method of learning.To what extent can artificial intelligence be produced as a result of machine learning and deep learning? Can they surpass human intelligence? We think all AI nowadays are weak artificial intelligence, not strong artificial intelligence. A strong artificial intelligence machine has its own consciousness, but certainly, none of our machines now has it.We think machine and deep learning, like data science in general, is as much art as science. When start studying the AI field, head may turn in the beginning about models, data sets, methods and all. We would encourage to pick a favorite ML domain and going deeper. It is computer vision forus these days. The fluency only comes with practice like everything else in life. We will see many more news and inventions in AI domain in 2019. We also expect to see more advances and applied cases at the “edges” for ML to be available with mobile phones, ear buds, watches and other portable devices beyond high power computers only. So beware for more. We would like to finish with one of favourite quotes from SatyaNadella“I believe in a world that will have an abundance of artificial intelligence, but what will be scarce is real intelligence and human qualities, like empathy. I think great innovation comes from the empathy you have for the problems you want to solve for people”.

References

1. Samuel, A. L. (1959). "Some Studies in Machine Learning Using the Game of Checkers". IBM Journal of Research and Development. 3 (3): 210–229.
2. Minsky, M. (1961) “Steps Toward Artificial Intelligence,” Proceedings of the IRE, 8-30.
3. Schank, Roger C. (1991). "Where's the AI". AI magazine. Vol. 12 no. 4. p. 38.
4. Bresnahan, T. and S. Greenstein (1999) “Technological Competition and the Structure of the Computer Industry,” Journal of Industrial Economics, 47(1), 1-40.
5. Nilsson, N. (2010), The Quest for Artificial Intelligence: A History of Ideas and Achievements, Cambridge University Press.
6. Davis, Ernest; Marcus, Gary (2015). "Commonsense reasoning and commonsense knowledge in artificial intelligence". Communications of the ACM. 58 (9): 92–103.
7. Jordan M. I., Mitchell T. M. (2015). "Machine learning: Trends, perspectives, and prospects". Science. 349 (6245): 255–260.
8. Leung, M.K.K., A. Delong, B. Alipanahi, and B.J. Frey (2016) “Machine Learning in Genomic Medicine: A Review of Computational Problems and Data Sets,” Proceedings of the IEEE, 104(1): 176-197.
9. Smoliar Stephen W. ,Zhang, Hong Jiang (1994). "Content based video indexing and retrieval". IEEE Multimedia. 1 (2): 62–72.
10. Pennachin C.,Goertzel B. (2007). Contemporary Approaches to Artificial General Intelligence. Artificial General Intelligence. Cognitive Technologies. Cognitive Technologies. Berlin, Heidelberg: Springer.
11. Cao Yongcan ,Yu Wenwu, Ren Wei, Chen Guanrong, (2013). "An Overviw of Recent Progress in the Study of Distributed Multi-Agent Coordination". IEEE Transactions on Industrial Informatics. 9 (1): 427–438.
12. Poria Soujanya, Cambria Erik, Bajpai Rajiv, Hussain Amir (2017). "A review of affective computing: From unimodal analysis to multimodal fusion". Information Fusion. 37: 98–125.
13. McCarthy John (1988). "Review of The Question of Artificial Intelligence". Annals of the History of Computing. 10 (3): 224–229.

