Deep Learning

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Sources Cited

http://sanghv.com/download/soft/machine%20learning,%20artificial%20intelligence,%20mathematics%20ebooks/ML/learning%20deep%20architectures%20for%20AI%20%282009%29.pdf (1)

http://www.cse.msu.edu/~weng/research/CresceptronIJCNN1992.pdf (2)

http://www.technologyreview.com/news/540396/using-deep-learning-to-make-video-surveillance-smarter/ (3)

https://gigaom.com/2014/11/20/deep-learning-might-help-you-get-an-ultrasound-at-walgreens/ (4)

http://www.nature.com/nature/journal/v323/n6088/pdf/323533a0.pdf (5)

http://www.bloomberg.com/news/articles/2014-01-27/google-buys-u-k-artificial-intelligence-company-deepmind (6)

http://www.seattlerobotics.org/encoder/nov98/neural.html (7)

http://www.technologyreview.com/sites/default/files/images/rothberg_patent.png (8)

https://medium.com/s-c-a-l-e/how-baidu-mastered-mandarin-with-deep-learning-and-lots-of-data-1d94032564a5 (9)

http://blogs.skype.com/2014/12/15/skype-translator-how-it-works/ (10)

http://dl.acm.org/citation.cfm?id=1553486 (11)

http://www.technologyreview.com/news/539226/ibm-pushes-deep-learning-with-a-watson-upgrade/ (12)

http://www.datarobot.com/blog/a-primer-on-deep-learning/ (13)

http://venturebeat.com/2015/10/08/youtube-now-uses-deep-learning-to-pick-better-video-thumbnails/ (14)

http://www.goldengooseaward.org/awardees/out-of-sight-neuroplasticity-and-vision (15)

http://www.wired.com/2013/05/neuro-artificial-intelligence/ (16)

http://www.ais.uni-bonn.de/deep_learning/images/Object_Class_Segmentation.jpg (17)

http://4.bp.blogspot.com/-Q4ld3f5VShg/VhVGKDb3v9I/AAAAAAAAAvE/EwdS61_72c4/s1600/image02.png (18)

https://skypeblogs.files.wordpress.com/2013/09/skype-logo-feb_2012_rgb_500.png (19)

https://upload.wikimedia.org/wikipedia/en/3/31/Watson's_avatar.jpg (20)

http://www.cs.toronto.edu/~graves/handwriting.html (21)

http://googleresearch.blogspot.com/2015/06/inceptionism-going-deeper-into-neural.html (22)

http://andrewyuan.github.io/img/DeepLearning.png (23)

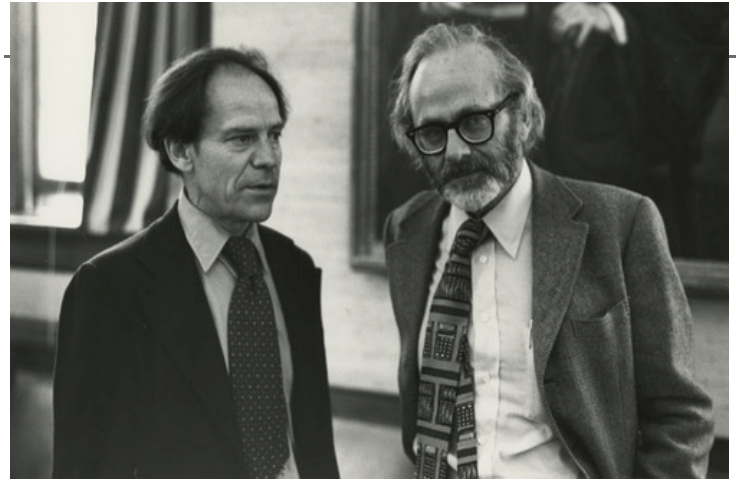
Presentation Overview

- ❏History
- ❏What is Deep Learning?
- ❏How does it work?
- ❏Current Applications of Deep Learning
- ❏Future Applications of Deep Learning
- ❏Further Reading

History

Artificial neural network – 1959 biological model by Nobel laureates David H. Hubel & Torsten Wiesel (2)

Key to deep learning: Observe data and form connections



(15)

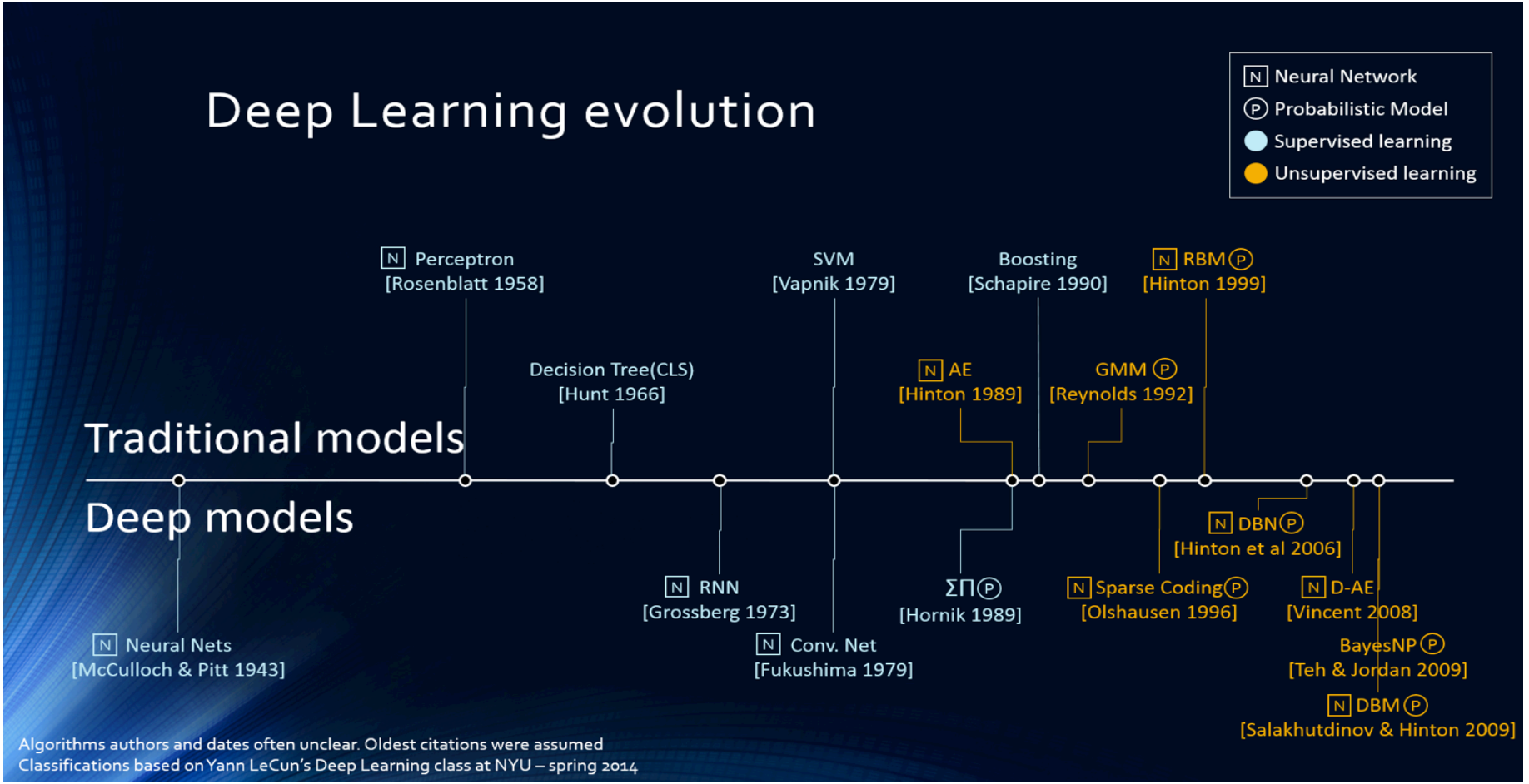
Image source: http://www.goldengooseaward.org/awardees/out-of-sight-neuroplasticity-and-vision

History

Andrew Ng, formerly of Stanford, Google and currently working at Baidu, is considered one of the leading experts of the contemporary deep learning movement

(16)

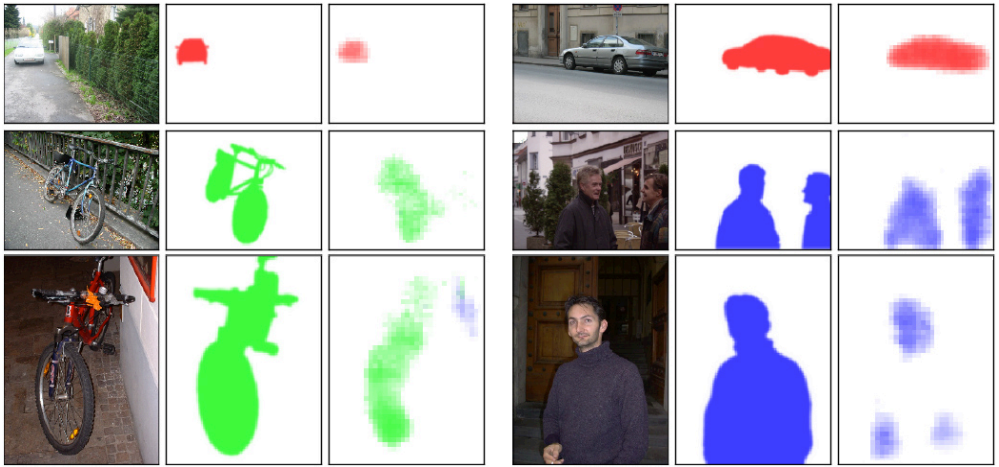
Research in this field focuses on the question, “How can we make better representations and create models to learn these representation from large scale data?”



(23) Image source: http://andrewyuan.github.io/img/DeepLearning.png

What is Deep Learning?

Deep learning refers to a set of machine learning algorithms, usually based on artificial neural networks, that attempts to model high- level abstractions in data. (1) These models are useful for developing ways to represent data. The data, which could be a word, pixel, single frequency, etc., may have little meaning by itself but a combination of these can represent something useful. (13) By itself, deep learning is useful for very specific scenarios and requires the use of other machine learning models and techniques to create more meaningful results



What is Deep Learning?

There are various deep learning models used in research and business. Some popular ones include:

- convolutional neural network (very useful for image recognition)
- deep belief network
- feed-forward neural network

Many deep learning models draw inspiration from biological processes

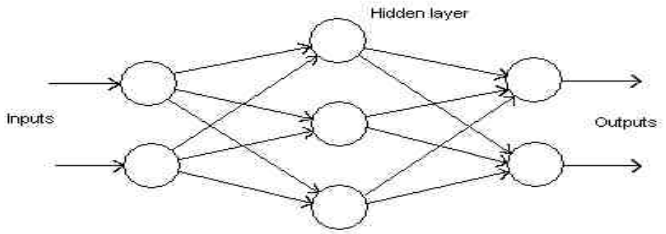
Parallel graphics processor clusters are well-suited, more so than multi-core CPU clusters, for performing deep learning model computations (11)

Deep learning can be used in both unsupervised and supervised learning.

How does it work?

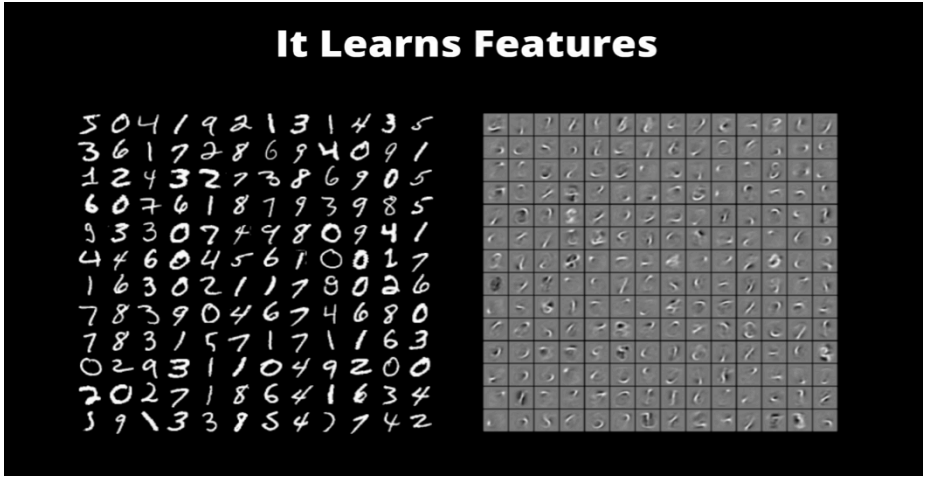
Backpropagation is a popular algorithm that puts the “learning” in deep learning for many models

- The idea was introduced during the 1970s and popularized in a 1986 paper by Rumelhart, Hinton, & Williams (5)
- An example using a simple feed-forward neural network
    - A layered network of “neurons” with synaptic weights

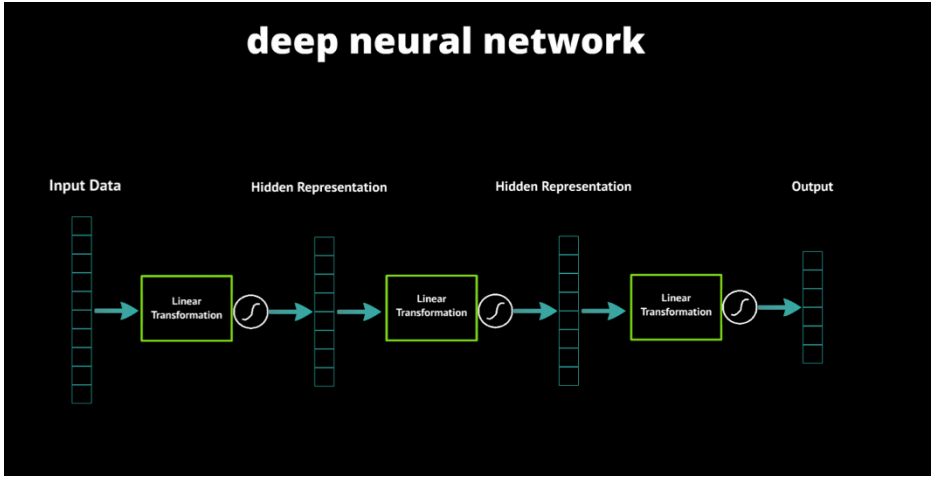


    - Forward propagate input through the network and generate output
    - Calculate error signal based on output and propagate backwards through network
    - At each layer, change weight at each synapse to help reduce error signal

Basically...



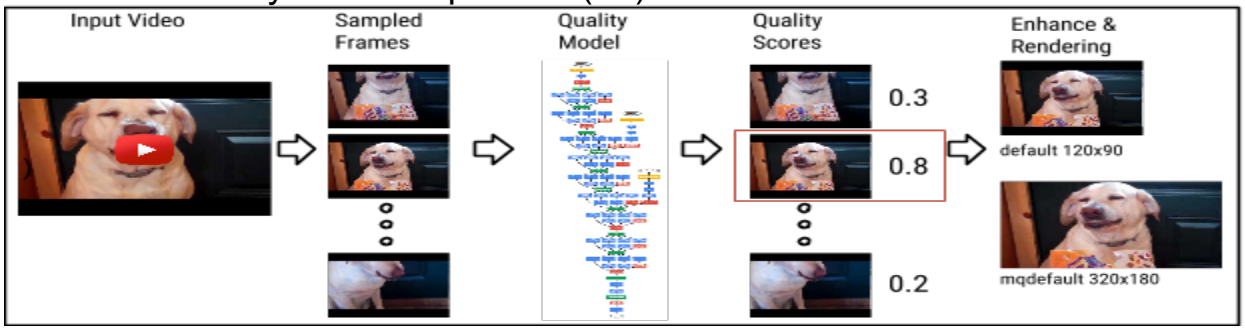
Using….



Current Applications of Deep Learning

DeepMind(6), currently owned by Google, was inspired by the approach taken in creating A.I that learn to play chess. Instead of creating algorithms, focused on thinking steps of moves ahead and then prioritizing different strategies before making the next move, a new approach was used where a chess computer learned to evaluate positions on the board, much like a human does. This led to a new machine that performs as an efficient neural network. Nodes in this network are connected and change as the system is trained.

Youtube uses a deep neural network model to generate higher-quality thumbnails for videos, which were preferred 65% more in a side-by-side comparison (14)



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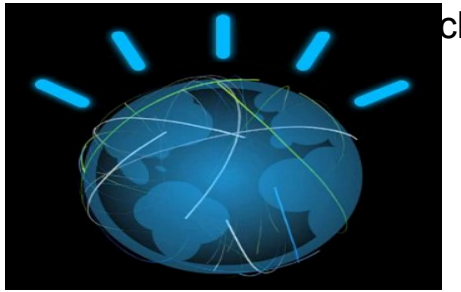
Current Applications of Deep Learning

Microsoft utilizes Deep Neural Networks to reduce error rates and increase robustness for their Skype Translator service, which provides near real-time translation for up to 50 different languages (10)

(19)

IBM has recently released three deep learning

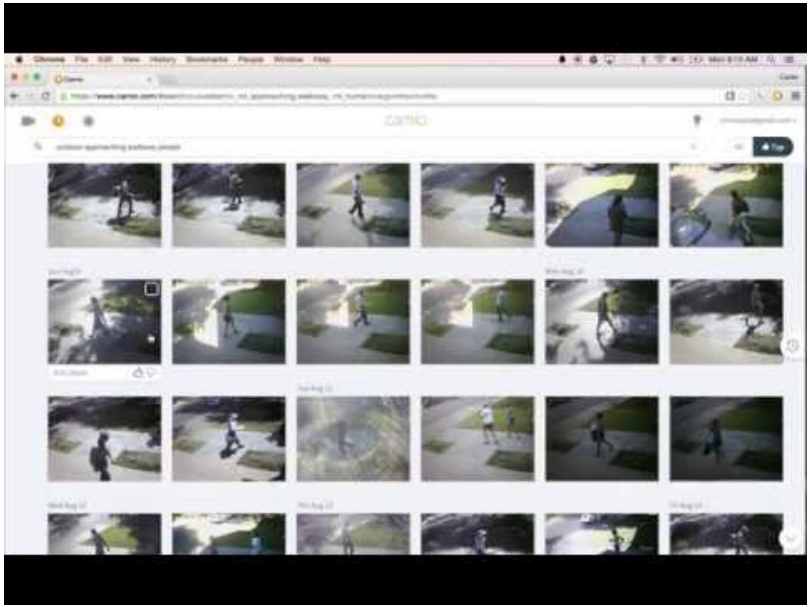


ch-to-text, and text-to-speech, to their Watson API (12)

Image source: https://skypeblogs.files.wordpress.com/2013/09/skype-logo-feb_2012_rgb_500.png
https://upload.wikimedia.org/wikipedia/en/3/31/Watson's_avatar.jpg

Current Applications of Deep Learning

Video monitoring company, Camio, utilizes deep learning to help identify “interesting” objects, such as dogs, trucks, or people, from camera surveillance videos. (3)



Current Applications of Deep Learning

Handwriting recognition/replication

http://www.cs.toronto.edu/~graves/handwriting.html (21)

Google employs deep learning algorithms within a wide spectrum of their services, including Google Translate, Google Voice, and Google Photos

Google Deep Dream Demo

Explanation for the images seen in this video can be found here:

http://googleresearch.blogspot.com/2015/06/inceptionism-going-deeper-into-neural.html (22)

Future Applications of Deep Learning

Medical imaging

- Butterfly Networks Inc. are developing a cheap, simple chip utilizing radio telescope technology, cloud computing, and deep learning models for faster and more accurate medical scans (4)

(8)

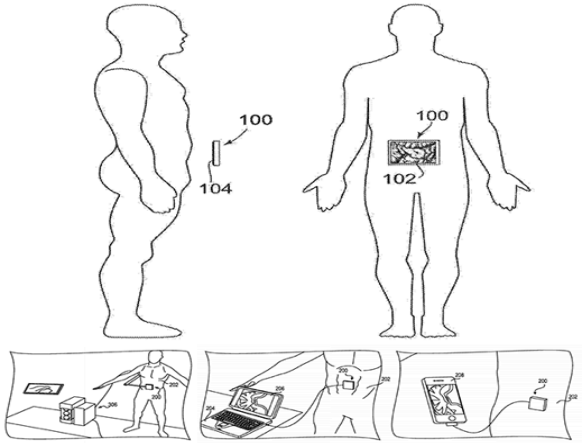


Image source: http://www.technologyreview.com/sites/default/files/images/rothberg_patent.png

Future Applications of Deep Learning

Natural language processing

- Baidu is working on a translation service, called Deep Speech, to transcribe voice queries in Mandarin (9)

Better recommendation systems

- Useful for a variety of popular services, such as Spotify and Netflix

Many tech companies have created deep learning teams including Google, Yahoo, Baidu, Twitter, and Pinterest

Although the ideas behind deep learning have been around since the 80’s, recently there has been a surge of viable business applications, which will provide a big boost to the progress of deep learning research

Conclusion

Deep Learning is an extensive and powerful tool that could have a major impact across a variety of industries. Although the concept has been around for decades, due to newfound interest from tech companies and investors, deep learning is only now burgeoning into a major area of interest for those in the AI field. Deep learning may not be the best tool for every job, but it is highly effective and practical for many business applications.

Further reading

For an in-depth introduction to deep learning:

http://neuralnetworksanddeeplearning.com/

Brief overview on some popular deep learning models:

http://www.toptal.com/machine-learning/an-introduction-to-deep-learning-from-perceptrons-to-deep-networks

Comprehensive list of topics and articles related to deep learning:

http://deeplearning.net/