



Deep Learning for Human Decision Support



Deep learning is a fast growing subfield of machine learning and artificial intelligence based on artificial neural networks and how the human brain learns. Its algorithms use hierarchical, non-linear layers to represent data at increasing levels of abstraction. Deep learning has been applied to fields such as computer vision, automated speech recognition, natural language processing, medical diagnostics, social media, political forecasting, recommendation systems and bioinformatics. It is particularly relevant in an age of big data and the Internet of Things.

Enabling Science and Technology

Architectures



Deep learning uses a variety of families of architectures, made up of groups of algorithms, to perform

classification and recognition tasks. Each architecture tends to be favoured for a particular set of tasks. Convolutional Neural Networks (CNN) are predominantly used for imaging tasks while Deep Neural Networks (DNN) are mainly used for natural language processing of speech tasks.

Surveillance



Deep learning, which facilitates the analysis of vast amounts of video

footage (often in real-time) to detect individuals and changes in their behaviour, is a technology area that has recently seen significant investment and research. Deep learning has been used in dynamic data-driven application systems (DDDAS) for real time activity recognition for situation awareness in Intelligence Surveillance and Reconnaissance (ISR) missions.

Event Detection



Acoustic Event Detection (AED) is sometimes a part of the broader activity of multimedia event detection

which seeks to combine multiple features (e.g. appearance, colour, texture, motion and audio) from several modalities, and has applications in automated surveillance, machine hearing and auditory scene understanding.

Recommender systems



Recommendation systems (RS) that use deep learning have overcome many of the traditional problems

of collaborative filtering and data sparsity, showing improved accuracy with added context-awareness. RS systems can support military activities related to detection of insider threats, monitoring of network security, prioritizing defence actions and expediting other analyses.

With AI we have the opportunity to move beyond traditional thinking about decision-support systems to build systems that see, hear, understand and collaborate with us to help make decisions faster, more relevant and better informed.

– Gayle Sheppard, general manager of Saffron Technology

Future Research



In a series of recent interviews with some of the top names in deep learning (e.g. Skymind, OpenAI, Google, etc.), the

most frequently mentioned areas of deep learning research that are expected to be advanced in the coming years are related to deep unsupervised learning, improvements to and automation of some decision making, and learning that persists beyond individual datasets.

Signals

Academic



MIT has developed a microchip called Eyeriss that can be used in pocket-sized devices to perform deep learning functions, thereby reducing data processing and supporting human analysis in the field.

◆ ***Accurately classifying raw data and using that to make better decisions can apply to almost every industry. And with deep learning, the improvements in accuracy are a quantum leap beyond what used to be possible.***

– Chris Nicholson, Founder and Ceo of SkyMind

Government



The US Air Force Research Lab, DARPA and IARPA all have research programs on deep learning, ranging from data fusion and analytics to intermodal video analytics and target recognition.

Collaboration



Amazon, Facebook, Google, IBM and Microsoft, with academics and non-profit organizations, launched the Partnership on Artificial Intelligence in 2016. It aims to advance public understanding of, and formulate best practices in A.I. and deep learning.

Collaboration



The University of Toronto, an international leader in the field of deep learning, has numerous collaborations with Microsoft, Google, IBM and Facebook, primarily related to speech recognition, acoustic modeling and image analysis applications.

Corporate



Microsoft, Google and IBM are leaders in the field with over 100 publications each in recent years. In terms of deep learning for decision support, all are focused on forecasting/prediction, data mining, and big data analytics.

Impact

Social



Public fears about the future impacts of AI and deep learning include the prospect of economic dislocation, loss of jobs and the science-fiction based fears about machines acquiring the ability to upgrade themselves without human oversight.

Policy



It is difficult to decipher how deep neural networks reach insights and conclusions, making their use challenging in cases where transparency of decision making is required for regulatory purposes. Ethical guidelines will be critical to ensuring confidence in decisions based on deep learning.

Economic



Data analysis, which will accelerate as deep learning technology develops the capabilities to reason and make decisions, will alter the dynamics in many industries. There will be enormous opportunities as well as significant risks—not only for individual companies but for society as a whole.

Environmental



Deep learning applications can support environmental monitoring through improved animal and event detection, and improve natural resource management through the optimization and control of distribution systems (e.g. water distribution systems).

Defence



Defence-related applications that process large amounts of streaming data, such as real-time intelligence collection, high altitude surveillance, and target recognition can all benefit from deep learning.

◆ ***The (CIA) has significantly improved its “anticipatory intelligence”...Deep learning and other forms of machine learning can help analysts understand how seemingly disparate data sets might be linked or lend themselves to predicting future events with national security ramifications.***

– Andrew Hallman, Deputy Director for Digital Innovation, CIA

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Please provide feedback

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