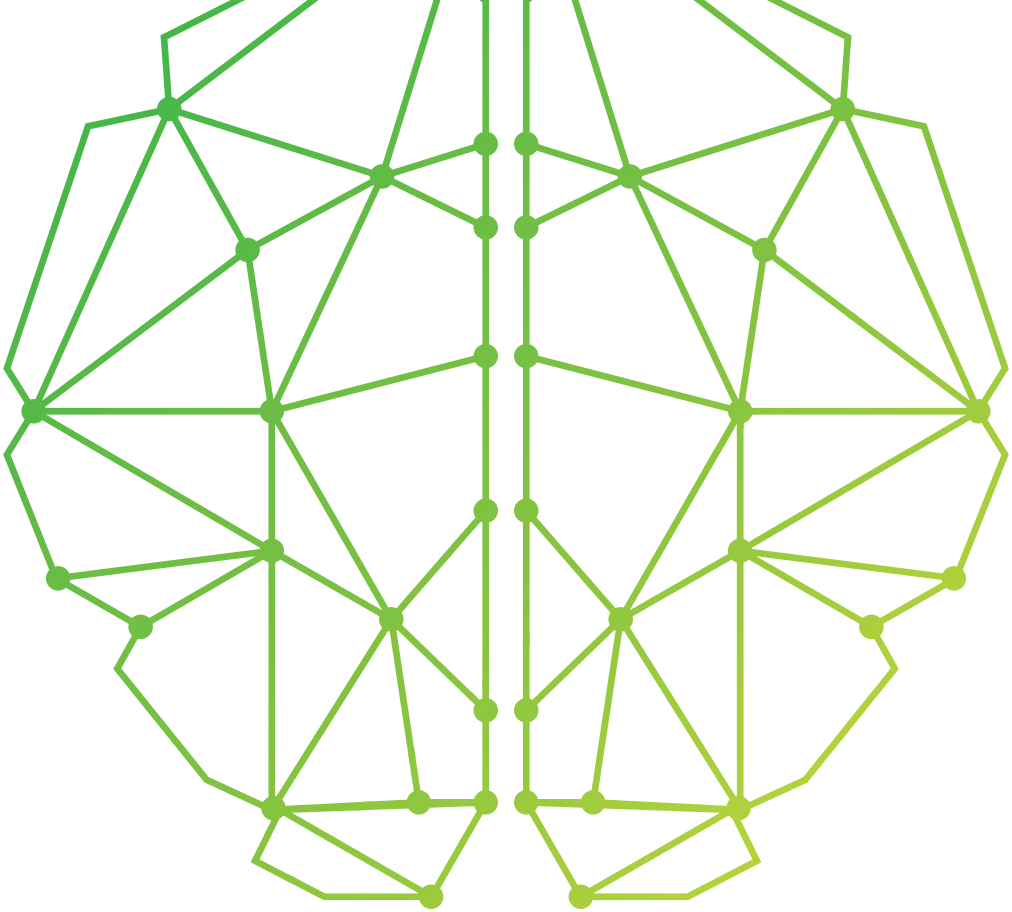

Mini Lexicon on Artificial Intelligence

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Lawyers

In today's reality, it is impossible to avoid integrating artificial intelligence solutions. There are numerous AI applications that can increase productivity, accelerate wealth creation or influence decision-making within your organization.

It is essential that you properly understand the most common terms used before introducing these new technologies. Any misunderstanding about the technologies in play in a given situation might cause their capacities to be underused or their vulnerabilities to be overlooked.

Below is a short lexicon to help clarify and demystify the most common terms used in artificial intelligence.

Happy Reading!

> Artificial Intelligence

A set of technologies that simulate human intelligence. For the moment, the notion of artificial intelligence remains an amalgam of various characteristics. This very large area includes supervised, unsupervised and reinforcement learning methods.

> Machine Learning

Machine learning is an extensive family of methods that allows a machine to learn behaviour based on situations input in a supervised, semi-supervised or unsupervised manner.

> Supervised Learning

Learning methods where the results an artificial intelligence system is expected to produce for a given situation are input so that they will be reproduced by the system. The system then learns by comparing its errors against the desired results in order to minimize subsequent errors. Backpropagation is an example of a supervised learning strategy.

> Reinforcement Learning

This method teaches an artificial intelligence system by inputting an environment with various situations. The system is then rewarded for its cumulative behaviour, which guides it in its learning.[1] Contrary to supervised learning, the system does not receive any direct instructions as to the desired result for a given situation. This method therefore allows the system to learn how to process new situations for which it has not been previously trained. This approach is commonly used in robotics and is the type of method that enabled the famous *AlphaGo* software to defeat the Go world champion,[2] a result that was unthinkable until recently.

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1 See: Doshi, F., Pineau, J., & Roy, N. (2008, July). Reinforcement Learning with Limited Reinforcement: Using Bayes Risk for Active Learning in POMDPs. In Proceedings of the 25th International Conference on Machine Learning (pp. 256-263). ACM.

2 Gibney, E. (2016). What Google's winning Go algorithm will do next. Nature, 531(7594), 284-285.

> Deep Learning

Multi-layered neural network allowing a high degree of abstraction. These networks are trained using a backpropagation method.[3] This method has been considerably developed in recent years and is largely responsible for the current popularity of artificial intelligence. There are multiple applications, including visual face and object recognition, automated language processing and medical scientific research.

> Artificial Neural Networks

This is a form of computer program that can be mapped *somewhat* like biological neurons without, however, actually reproducing the human brain! Neural networks are generally algorithms that proceed by supervised learning. This method is used to process data in probabilistic problems and preferably to process large amounts of data. Artificial neurons correspond to different characteristics of the data supplied and are interconnected to combine several characteristics. The method can be applied to unlimited visual, textual, sound or other characteristics, depending on the type of content.

> Perceptron

Developed in the 50s,[4] this is the first form of artificial neural network and probably one of the simplest. In fact, neural networks have been around for a while. A perceptron is only the first in a long series of types of algorithms used.

> Backpropagation

"Gradient descent backpropagation", to use its full name, is a method that allows neural networks to learn. More specifically, if data is input into a neural network with the desirable and undesirable results identified, the method allows the relative weight of neurons corresponding to the desirable results to be increased or decreased. This method allows a neural network to learn how to distinguish a correct answer from an incorrect one.

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3 See: LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. Nature, 521(7553), 436-444.

4 Rosenblatt, F. (1958). The perceptron A probabilistic model for information storage and organization in the brain. Psychological review, 65(6), 386.

> Genetic Algorithm

A method that studies a set of possible solutions and eliminates the worst solutions. The best solutions are combined and studied successively until an optimal solution is reached.

> Expert Systems

Software that applies pre-defined rules, in particular to assist decision-making. These rules are often static, contrary to learning algorithms, and can be mapped as decision trees, where the answers to specific questions cause the system to pose increasingly precise questions. Expert systems are quite widespread, particularly in the medical field for diagnostic purposes.

> Natural Language Automated Processing

Techniques to enable computers to understand humans directly. Natural language automated processing can be designed by writing or orally and allows the computer to process information that is not inputted using a pre-defined format, but in a natural language. There are multiple applications, including speech recognition, spam detectors, automated translation and sentiment analysis.

> Data Mining

Also called "data analysis", data mining examines large amounts of data in an automated manner to extract specific information. This information is generally useful to build models, often using unsupervised methods. It is often a way for businesses to extract relevant information on clients, the market and their activities.

> Turing Test

Developed in 1950 by Alan Turing,[5] a famous computer pioneer, this type of test is used to determine if a machine can exhibit intelligent behaviour. To pass the test, a computer must fool a human evaluator so that they are unaware that they are speaking with a computer. If today computers can fool humans in specific contexts, such as chatterbots or chat bots, they remain unable to do so in a more generalized context where a conversation can discuss several subjects.

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[5] Turing, A. M. (1950). Computing machinery and intelligence. Mind, 59(236), 433-460.

> CAPTCHA (*Completely Automated Public Turing test to tell Computers and Humans Apart*)

CAPTCHA is a type of Turing test applied to humans! You pass the test when you copy words using distorted or blurry images on the Internet to access a page or service. These simple tests prevent a computer program from systematically accessing a database to explore the information without authorization. When you pass such a test, you confirm that you are not a robot or an artificial intelligence.[6] However, deep learning has made it increasingly easy for computers to thwart such tests. [7]

> Artificial Intelligence Winters

As you can see by reading this lexicon, artificial intelligence itself is not new. The evolution of these technologies has been marked by major periods or slowdowns, often related to loss of funding. For example, in the middle of the 70s, funders significantly reduced grants for this type of work in the face of evidence that artificial intelligence systems were not delivering the results announced by researchers at the time. Funding was once again reduced at the end of the 80s. Ironically, these periods contributed to developing clusters of leading researchers in countries where funding was more stable and more focused on basic research, including Canada. Some believe that Canada's success in artificial intelligence is due to these AI winters!

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6 Von Ahn, L., Blum, M., Hopper, N. J., & Langford, J. (2003, May). CAPTCHA: Using hard AI problems for security. In International Conference on the Theory and Applications of Cryptographic Techniques (pp. 294-311). Springer, Berlin, Heidelberg.

7 Bursztein, E., Aigrain, J., Moscicki, A., & Mitchell, J. C. (2014, August). The End is Nigh: Generic Solving of Text-based CAPTCHAs. In WOOT.

MATHEMATICAL AND COMPUTER CONCEPTS

Artificial intelligence also uses various earlier mathematical and computer concepts. While this isn't artificial intelligence strictly speaking, an understanding of these concepts may be vital to understanding the systems into which they are integrated.

> Simplex Algorithm

This method was developed during World War II by mathematician George Dantzig.[8] It seeks the optimal solution to a problem, for example to optimize a production line. This algorithm can be calculated by hand, but it and its derivatives are today integrated into several production and supply management computer solutions.

> Agent

Not a man with a tie but a computer program that acts independently! This includes bots that interact on the Internet. Certain systems rely on a multitude of agents interacting together. A new category of agent, often called smart agents, is capable of learning. The more traditional agents are incapable of learning.

> Bayesian

Refers to statistical methods discovered by Thomas Bayes in the 18th century and those that resulted. This approach is particularly interested in the probability of a result given the observed data.[9] It is particularly useful when there is a limited amount of data to analyze, for example, for financial predictions based on the probability of different events, such as the probability of an increase in the stock market *given* an increase in the prime rate.

> Heuristic

A method that is not based on a formal model and that provides a quick, albeit non-optimal, result.

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8 See: Dantzig, G. B. (1963). Linear Programming and Extensions. Princeton landmarks in mathematics and physics.

9 Fienberg, S. E. (1992). A Brief History of Statistics in Three and One-Half Chapters: A Review Essay. Statistical Science, 7(2), 208-225.

> Stochastic

Refers to a mathematical method with some random variables. These methods are used to understand natural phenomena, as well as socio-economic phenomena such as the stock market.

> Principal Component Analysis

A data analysis method developed by Karl Pearson at the beginning of the 20th century, whose roots can be traced back to works in the 19th century,[10] which transforms data with a large number of variables into a set with fewer independent variables, making it easier to process. This method is used to process images and social data to extract its most important elements.

> Hidden Markov Model

Mathematician Andrey Markov had nothing particular to hide! This is in fact a statistical model that considers that only certain observable results are known to the user, but that the steps in the process leading to the results are unknown, and therefore "hidden". This model is widely used in artificial intelligence, particularly for reinforcement learning.

> Blockchains

Protocols that ensure a database is secure and can be published throughout a network. By virtue of its distributive nature, this type of database can be very difficult to corrupt or falsify. This type of protocol is used for cryptocurrencies and certain smart contracts, which are computer protocols with specific self-executing contractual obligations.

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[10] Abdi, H., & Williams, L. J. (2010). Principal component analysis. Wiley interdisciplinary reviews: computational statistics, 2(4), 433-459.

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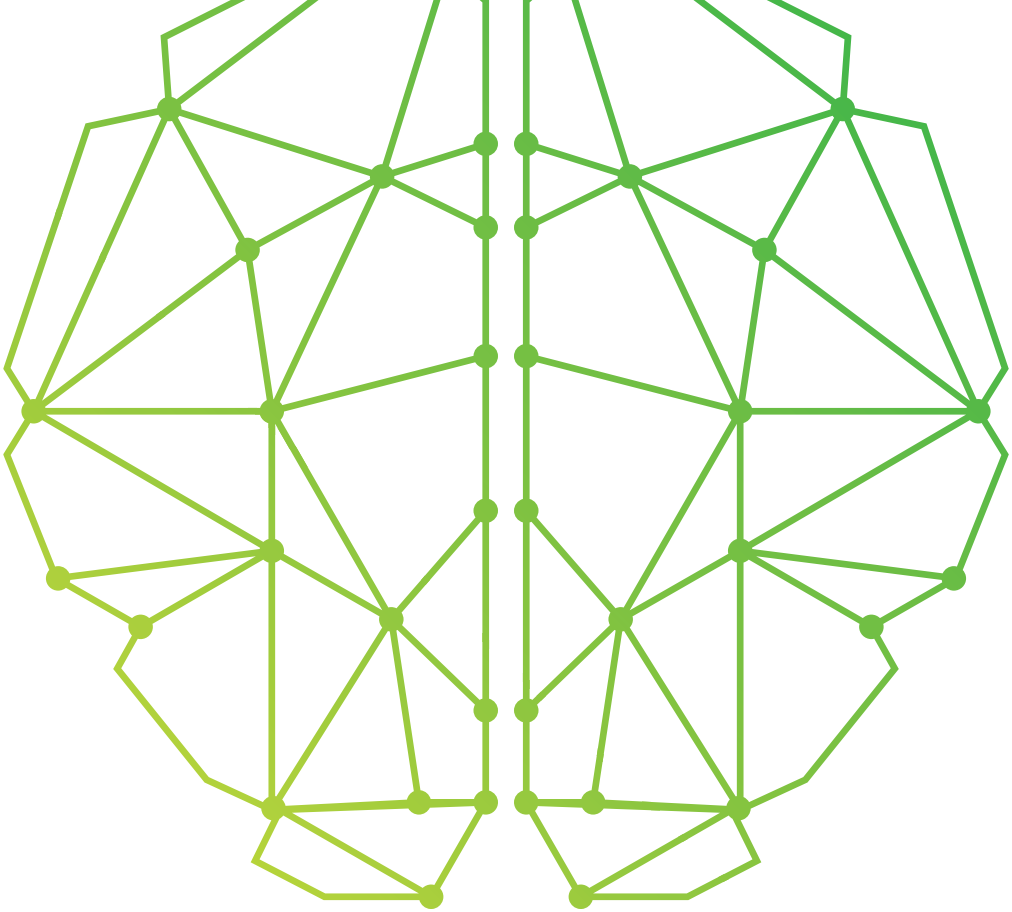
Eric Lavallée is a lawyer, trademark agent and head of the Lavery L^{3}AI Lab. He holds a Master's degree in physics and a doctorate in electrical engineering. He has expertise in nanotechnology and he has developed four inventions related to electron-beam lithography for microelectronic applications.

Mr. Lavallée practises in the areas of intellectual property, protection of personal information, corporate governance as well as the analysis of the legal impact of AI on business law. Mr. Lavallée is regularly called upon to advise businesses of all sizes, from start-ups to major corporations. He drafts high-tech licensing and commercial agreements and implements intellectual property protection strategies and due diligence.

Lavery created the Lavery Legal Lab on Artificial Intelligence (L^3AI) to analyze and monitor recent and anticipated developments in artificial intelligence from a legal perspective. Our Lab is interested in all projects pertaining to artificial intelligence (AI) and their legal peculiarities, particularly the various branches and applications of artificial intelligence which will rapidly appear in companies and industries.

We would like to thank Professor Pierre-Marc Jodoin of the Université de Sherbrooke for his invaluable assistance in preparing this lexicon.



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