

# AI, Machine Learning, & Deep Learning Explained in 5 Minutes

The difference between the three and how each of them works.



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Apr 3, 2018 · 6 min read



The term “Artificial Intelligence” has been floating around for a while. We see it in sci-fi movies, “AI” game bots we play against, Google search, and, oh yeah, those robots that are some day going to take over the world. Off late, though, “Machine Learning” and “Deep Learning” have surfaced, with many asking what exactly each of these are.



## Artificial Intelligence

Artificial Intelligence is the general category, common to all three. In a diagram, Artificial Intelligence would be the bigger, encapsulating circle that contains Machine and Deep Learning. AI is basically any intelligence demonstrated by a machine that leads it to an optimal or suboptimal solution given a problem. The simplest AI example can be

found in the form of a Tic-Tac-Toe AI player; if a bot follows the following preprogrammed algorithm, it will never lose a game: (courtesy of Wikipedia)

1. *If someone has a “threat” (that is, two in a row), take the remaining square.*
2. *If a move “forks” to create two threats at once, play that move. Otherwise,*
3. *Take the center square if it is free. Otherwise,*
4. *if your opponent has played in a corner, take the opposite corner. Otherwise,*
5. *take an empty corner if one exists. Otherwise,*
6. *take any empty square.*



MAY 15–17, 2018 | SAN FRANCISCO

Now, an algorithm like this doesn't possess the cognitive, learning, or problem solving abilities that most people associate an “AI” with. And yet, the algorithm is simply an agent that leads to the optimal solution given a problem and its state.

Wikipedia gives another definition for an Artificial Intelligence agent:

*any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals*

Agents that fall under AI but not Machine Learning are generally agents that solely utilize decision trees for logic, or agents built with rules and instructions.

## Top 3 Most Popular Ai Articles:

1. *A noob's guide to implementing RNN-LSTM using Tensorflow*
2. *Keras Cheat Sheet: Neural Networks in Python*
3. *Making a Simple Neural Network*

## Machine Learning: Signs of Cognition

Arthur Samuel coined the phrase “Machine Learning” in 1959, defining it as “the ability to learn without being explicitly programmed.”

Machine Learning, at its most basic form, is the practice of using algorithms to parse data, learn from it, and then make a determination or prediction about something in the world. The most common example for beginners is house prices. How does a site like Redfin or Zillow predict what the price of a currently-owned house is?

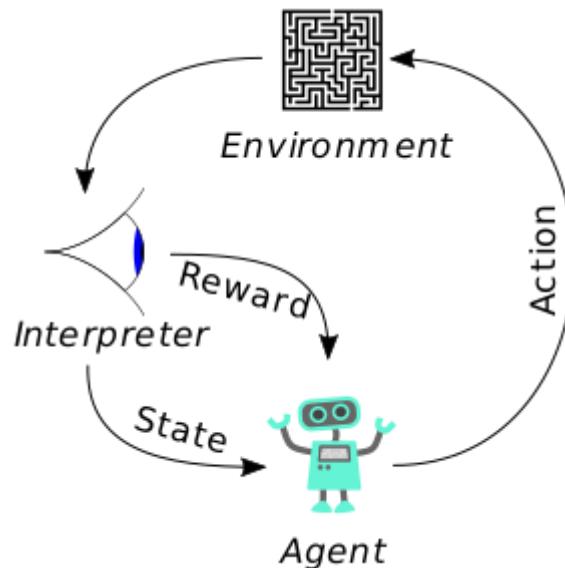
It’s not that complicated. Machine Learning, at its core, is really just making a line of best fit, except in many dimensions. A house price prediction model looks at a ton of data, with each data point having several dimensions like size, bedroom count, bathroom count, yard space, etc. It creates a function out of these input parameters, and then just shifts the coefficients to each of these parameters as it looks at more and more data.

This method of Machine Learning is called “Supervised Learning,” where the data given to the model includes the answer to the problem for each input set. It’s basically giving the input parameters, called features, and the outputs for each set of features, from which the model

adjusts its function to match data. Then, when given any other input data, the model can execute the same function and come up with an accurate output.

Other facets of Machine Learning are Unsupervised Learning and Reinforcement Learning. Concisely, Unsupervised Learning just finds similarities in data—in our house example, the data wouldn't include house prices (the data would only be input, it would have no output) and the model would be able to say “Hmm, well based on these parameters, House 1 is most similar to House 3” or something of the sort, but wouldn't be able to predict the price of a given house.

Reinforcement Learning is best explained with a simple, brief, diagram:



An agent takes actions in an environment, which is interpreted into a reward and a representation of the state, which are fed back into the agent. Think of a little baby: crying results in candy—the reward. Over time, if the parents keep satisfying the child's desire for candy, the baby will learn to cry every time he or she wants candy.

## Deep Learning: The Connection to Humans

Deep learning was inspired by the structure and function of the brain, namely the interconnecting of many neurons. Neural Networks are algorithms that mimic the biological structure of the brain.

From MIT News:

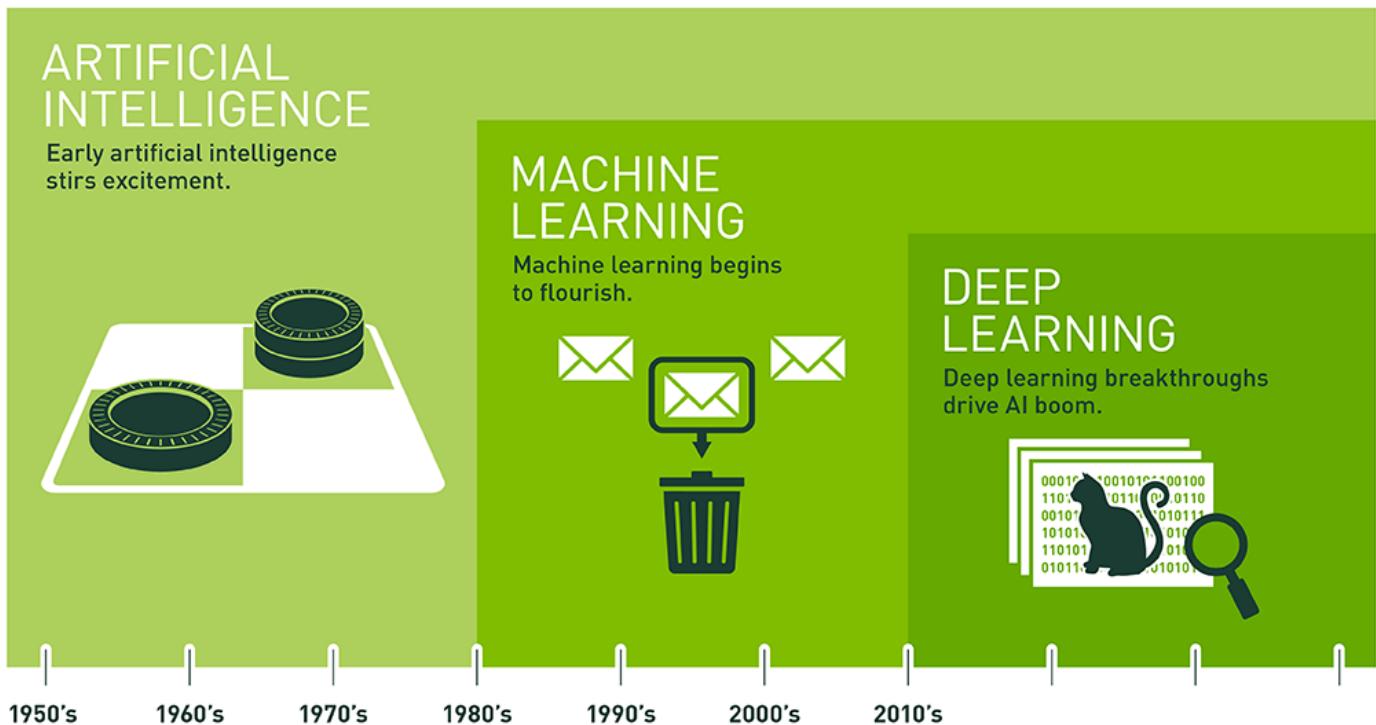
*Modeled loosely on the human brain, a neural net consists of thousands or even millions of simple processing nodes that are densely interconnected. Most of today's neural nets are organized into layers of nodes, and they're "feed-forward," meaning that data moves through them in only one direction. An individual node might be connected to several nodes in the layer beneath it, from which it receives data, and several nodes in the layer above it, to which it sends data.*

*To each of its incoming connections, a node will assign a number known as a "weight." When the network is active, the node receives a different data item—a different number—over each of its connections and multiplies it by the associated weight. It then adds the resulting products together, yielding a single number. If that number is below a threshold value, the node passes no data to the next layer. If the number exceeds the threshold value, the node "fires," which in today's neural nets generally means sending the number—the sum of the weighted inputs—along all its outgoing connections.*

*When a neural net is being trained, all of its weights and thresholds are initially set to random values. Training data is fed to the bottom layer—the input layer—and it passes through the succeeding layers, getting multiplied and added together in complex ways, until it finally arrives, radically transformed, at the output layer. During training, the weights and thresholds are continually adjusted until training data with the same labels consistently yield similar outputs.*

Deep Learning is basically Machine Learning on steroids. There are multiple layers to process features, and generally, each layer extracts some piece of valuable information. For example, one neural net could process images for steering a self-driving car. Each layer would process something different, like, for example, the first could be detecting edges for the sides of the road. Another layer could be detecting the lane lines in the image, and another possibly other cars.

That was a lot of information packed into many words. An image from NVIDIA provides an extremely compact visualization:



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Regardless of the differences, all three continue to make profound impacts on our world today, and one day, may lead us into a robotic society.

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