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Deep Learning

The Next Evolution in Programming

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Overview

The evolution of computing has seen radical advances over the past half century: the early mainframes of the 1950s, the introduction of artificial intelligence in 1956, the PC revolution of the 1980s, the advance of mobile infrastructure's arrival in the last decade, and the recent rise of big data and analytics.

Deep learning is another advancement essential to cognitive computing, as it partners computers with humans to help businesses automate labor-intensive processes. The new generation of computers goes beyond simple "yes" or "no" questions; now, they inhabit the realm of "how" and "why." Put succinctly, computers think and learn like human beings.

The effects are astounding, and the timing couldn't be better. With the growth of the Internet and the shift to online business, enterprises worldwide struggle every day to make sense of the staggering amount of unstructured data. Deep learning offers a solution.

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Unstructured data is information that's not formatted for computers to recognize, sort or analyze in a traditional database.

Defining Deep Learning

Ask 10 experts for a definition of deep learning, and they'll probably give you more than 10 correct answers.

Deep learning—a computational technique that uses neural networks—is based on the human brain's decision-making process. By building multiple layers of abstraction, deep learning technology can solve complex semantic problems.

Deep learning frees humans from doing mundane and repetitive tasks and enhances a computer's ability to learn the way humans do by eliminating the linear nature of most programs and leveraging sophisticated algorithms.

The world's most advanced computing systems use deep learning to intelligently decipher the overwhelming amounts of structured and unstructured data and make insightful business decisions. Deep learning teaches these systems to separate the signal from the noise, so they can analyze relevant data and interactions to better understand customer preferences and behavior.

Defining Deep Learning

Take email:

You could categorize your inbox by sender, recipient, date or another variable. But before the innovation of deep learning, the information within your emails had no predefined model or structure that would let a computer analyze it.

Deep learning can analyze many types of unstructured data, such as

- your medical records
- online product reviews
- images on social media
- song lyrics

Pattern Recognition

Here's an example of how deep learning works.

When you see a dog, your brain takes in the image of the dog and then, to properly identify that image, breaks it down into a variety of features. First, it identifies basic features, such as light versus dark and subject versus background. Then, shapes start to come into focus. You see a tail at the same time that you notice the object in question has four legs and pointy ears, pointy teeth, paws and fur.

It takes your brain's neural network 13 milliseconds to execute the thousands of computations it needs to conclude that the object you see is a dog. Each microdecision—separating light from dark, recognizing a tail, noticing teeth—is an example of what we call a layer of abstraction. While we humans can easily parse multiple layers of abstraction to analyze various types of data, that type of understanding posed a challenge for computers until very recently.

Because of deep learning, computers can now execute these actions for a variety of external stimuli beyond just images. In this way, deep learning is a monumental departure from the old, manual way of doing things.

Beyond Artificial Intelligence

Isn't "deep learning" just another term for "artificial intelligence"?

Yes and no. Deep learning falls under the umbrella of AI, but traditional AI follows a linear programming structure, limiting the ability for a computer to "learn" anything without human intervention.

Traditional AI	Deep Learning
Feature engineering	Hierarchical model with layers of abstraction
Human-annotated data types	Unlabeled data types
Sequential computation	Multiple decisions simultaneously

Beyond Artificial Intelligence

Deep learning aims to replace the linear programmatic structure with self-learning and self-teaching algorithms.

This progressive approach allows for a more advanced interpretation of data. For example, a computer running traditional AI could read a printed ZIP code off of an envelope—but deep learning could allow it to infer from the pink envelope and the date sent that the envelope contains a Valentine's Day card.

With deep learning, you're training the computer to make decisions—and even to express a degree of confidence in those decisions.

Deep Learning Every Day

Even if you haven't recognized it, you've benefited from deep learning.

Deep learning is

- how computers learn to spot cancer cells earlier. Rather than answering "yes" or "no" to the question "Are these cancer cells?" deep learning allows a computer to provide an answer, accompanied by a confidence score, based on available data.
- how streaming video services and online retailers know which programming and products interest you, based on more than just your browsing activity or what you've already watched and purchased.
- why you can ask a question and receive a better answer than from a typical web engine search result.
- the reason you can receive surprisingly accurate results from image, news and other complex search-engine queries.

Data, Algorithms, Hardware

Why is deep learning important now?

Three factors account for the increased use of deep learning:

1

The data.

With volumes of data too enormous for humans to handle efficiently and economically, deep learning not only helps you process your data, it lets you build strong deep learning systems that learn over time. The more data they ingest, the more they learn—and the more accurate your results become.

2

The algorithms.

Advances in algorithmic science and artificial intelligence have led to the development of deep learning models with high layers of abstraction that can be applied to a wide variety of complex situations and industries.

3

The hardware.

Cloud computing and GPUs mean supercomputer capabilities are a click away. Huge infrastructure build-outs that are costly and difficult to manage are no longer part of the picture.

The Benefits of Deep Learning

Key benefits of deep learning include

- the capability to develop hierarchical models across various types of data, including text, images, and audio and video.
- the ability to deduce meaningful patterns and knowledge from huge volumes of unstructured data.
- massive parallelism to allow for multiple processing cores—and even computers—to work efficiently with algorithms to maximize performance.

Deep learning's proficiency with and mastery of unstructured data is the driving force behind its wide adoption across such industries as retail, finance, and oil and gas.

As much as 85 percent of all business data is estimated to be unstructured. Organizations that use deep learning to unlock their data's potential for innovation have the edge in establishing themselves as industry leaders.

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More than 77,000 developers in 84 countries use IBM Watson™ APIs to find insights in more than 3 billion texts, images and other unstructured data every month.

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Deep Learning Starts Now

How and when will you start?

Thanks to easily accessible cloud computing power, almost any enterprise can take advantage of deep learning through a SaaS platform of cognitive APIs such as IBM Watson Developer Cloud.

Our APIs help developers and businesses use natural language processing and visual recognition to transform vast amounts of text, images and other unstructured data into information that helps inform business decisions that can radically change entire industries.

Get started with deep learning today. Discover the full suite of APIs available on **Watson Developer Cloud**—and start your free 30-day trial.