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Artificial neural networks are changing the world

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Анотація
У даній роботі особлива увага приділяється нейронним мережам - як вони впливають на комп'ютерну індустрію, на чому вони базуються, для чого використовуються.
Ключові слова: нейронні мережі, нейрон, штучний інтелект, машинне навчання

Abstract
This paper focuses specifically on neural networks - how they influence on computer industry, what they are based on, what they are used for.
Keywords: neural network, neuron, artificial intelligence, machine learning

Introduction

Since the invention of the computer, there have been people talking about the things that computers would never be able to do. Whether it was beating a grand master at chess or winning on Jeopardy!, these predictions have always been wrong. However, some such nay-saying always had a better grounding in computer science. There were goals that if you knew how computers worked, you knew they would be virtually impossible to achieve - recognizing human emotions through facial expressions; reading a wide variety of cursive handwriting; correctly identifying the words in spoken language; driving autonomously through busy streets.

Well, computers are now starting to be able to do all of those things, and quite a bit more. Were the nay-sayers really just too cynical about the true capabilities of digital computers? In a way, no. To solve those monumental challenges, scientists were forced to come up with a whole new type of a computer, one based on the structure of the brain. These artificial neural networks (ANNs) only ever exist as a simulation running on a regular digital computer but what goes on inside that simulation is fundamentally very different from classical computing.

Is an artificial neural network an exercise in computing science? Applied biology? Pure mathematics? Experimental philosophy? It's all of those things, and much more.

What are ANNs?

Most people have already known that the neurons that do the computation in our brain are not organized like the semiconductors in a computer processor in a linear sequence attached to the same board, and controlled by one unifying clock cycle. Rather, in the brain each neuron is nominally its own self-contained actor, and it's wired to most or all of the neurons that physically surround it in highly complex and somewhat unpredictable ways.

This means that for a digital computer to achieve an ordered result it needs one over-arching program to direct it and tell each semiconductor just what to do to contribute toward the overall goal. A brain, on the other hand, unifies billions of tiny, exceedingly simple units that can each have their own programming and make decisions without the need for an outside authority. Each neuron works and interacts with the neurons around it according to its own simple, pre-defined rules.

An artificial neural network is (supposed to be) the exact same thing, but simulated with software. In other words, we use a digital computer to run a simulation of a bunch of heavily interconnected little mini-programs which stand in for the neurons of our simulated neural network. Data enters the ANN and has some operation performed on it by the first "neuron," that operation being determined by how the neuron happens to be programmed to react to data with those specific attributes. It then passes' on to the next neuron, which is chosen in a similar way, so that another operation can be chosen and performed. There are a finite number of "layers" of these computational neurons, and after moving through them all, an output is produced.

The overall process of turning input into output is an emergent result of the programming of each individual neuron the data touches, and the starting conditions of the data itself. In the brain, the "starting conditions" are the specific neural signals arriving from the spine, or elsewhere in the brain. In the case of an ANN, they're anything we'd like them to be, from the results of a search algorithm to randomly generated numbers to words typed out manually by researchers.

What has attracted the most interest in neural networks is the possibility of learning. Learning means using a set of observations to find answer that solves the task in some optimal sense.

The cost function is an important concept in learning as it is a measure of how far away a particular solution is from an optimal solution to the problem to be solved. Learning algorithms search through the solution space to find a function that has the smallest possible cost.

For applications where the solution is dependent on some data the cost must necessarily be a function of the observations, otherwise we would not be modelling anything related to the data. It is frequently defined as a statistic to which only approximations can be made

When some form of online machine learning must be used, the cost is partially minimized as each new example is seen. While online machine learning is often used when it is fixed, it is most useful in the case where the distribution changes slowly over time. In neural network methods some form of online machine learning is frequently used for finite datasets.

Resume

So, to sum up: artificial neural networks are basically simulate the brains. But it's important to note that we can give our software "neurons" basically any programming we want; we can try to set up their rules so their behavior mirrors that of a human brain but we can also use them to solve problems we could never consider before.

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