An Expert System to Transfer Learning to Application

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Abstract

"What is Education? Is it Book learning? No. Is it diversified learning? Not even that. The training by which the current Learning and expression of the mind becomes Knowledge is real education"

– Swamy Vivekananda.

Many of us have learnt a lot in our life. Right from Kinder garden till the time we pursue Ph.D. Just close your eyes and think whether we remember any one of the best ideas that we learnt and that can be applied to modern problems of the society and needs. It's a very rare thing that our subconscious mind which is prone to millions of data inside us can't be in a position to pick up a specific law that we studied in physics in our school days or a program that we learnt in college days. Our brain forgets a lot of data that is stored inside us and remembers only few data which we are unaware to apply for real world problems. This paper gives a solution to create an Expert system to create a methodology where learning knowledge can be transferred into real world application. If this can be incorporated into every human mind, sure this world can see the best applications of knowledge which everyone possesses in them.

Keywords: Knowledge Management, Knowledge Transfer, Mind Learning

Introduction

Our Life and knowledge is God's gift to us. But it's a universal truth that man learns many things during his life time but never converts them into knowledge. He fails in transferring his learning, ideas to solve his own problem. It's true that according to a research, a normal or an expert human being uses only a maximum of 15% of his entire knowledge during his life time. Knowledge conversion is a universal quality which differentiates human beings from other organisms. It enables our senses to identify the changes in us and also to change ourselves to maintain tight situations in life. Hence this knowledge management scheme works well for people who likes to work out their problems with proper presence of mind and knowledge with skill incorporated from their everyday learning skills. To understand how the knowledge can be incorporated or transferred, its important to understand the working of our brain.

Capabilities of Human Brain

It's important to understand the complexity of the human brain. The human brain weighs only three pounds but is estimated to have about 100 billion cells. It is hard to get a handle on a number that large (or connections that small). Let's try to get an understanding of this complexity by comparing it with something humans have created--the entire phone system for the planet. If we took all the phones in the world and all the wires (there are over four billion people on the planet), the number of connections and the trillions of messages per day would NOT equal the complexity or activity of a single human brain.

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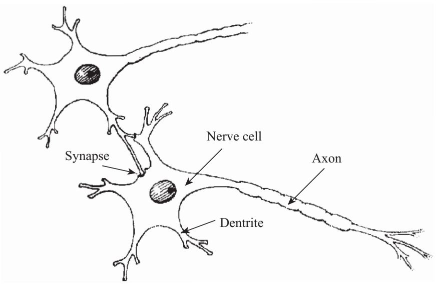
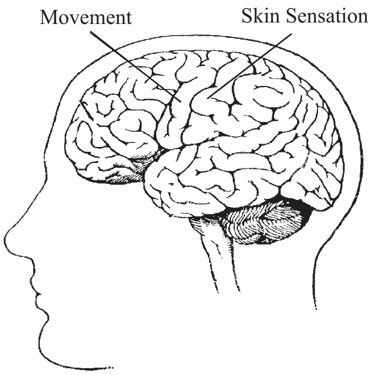


Now let's take a "small problem"--break every phone in Michigan and cut every wire in the state. How long would it take for the entire state (about 15 million people) to get phone service back? A week, a month, or several years? If you guessed several years, you are now beginning to see the complexity of recovering from a head injury. In the example I used, Michigan residents would be without phone service while the rest of the world had phone service that worked fine. This is also true with people who have a head injury. Some parts of the brain will work fine while others are in need of repair or are slowly being reconnected.

Building Blocks of Brain

Let's start looking at the building blocks of the brain. As previously stated, the brain consists of about 100 billion cells. Most of these cells are called neurons. A neuron is basically an on/off switch just like the one you use to control the lights in your home. It is either in a resting state (off) or it is shooting an electrical impulse down a wire (on). It has a cell body, a long little wire (the "wire" is called an axon), and at the very end it has a little part that shoots out a chemical. This chemical goes across a gap (synapse) where it triggers another neuron to send a message. There are a lot of these neurons sending messages down a wire (axon). By the way, each of these billions of axons is generating a small amount of electrical charge; this total power has been estimated to equal a 60 watt bulb. Doctors have learned that measuring this electrical activity can tell how the brain is working.



A device that measures electrical activity in the brain is called an EEG (electroencephalograph).

Each of the billions of neurons "spit out" chemicals that trigger other neurons. Different neurons use different types of chemicals. These chemicals are called "transmitters" and are given names like epinephrine, norepinephrine, or dopamine.

Knowledge Learning in Brain

How does information come into the brain? A lot of information comes in through the spinal cord at the base of the brain. Think of a spinal cord as a thick phone cable with thousands of phone lines. If you cut that spinal cord, you won't be able to move or feel anything in your body. Information goes OUT from the brain to make body parts (arms and legs) do their job. There is also a great deal of INCOMING information (hot, cold, pain, joint sensation, etc.). Vision and hearing do not go through the spinal cord but go directly into the brain.

Information enters from the spinal cord and comes up the middle of the brain. It branches out like a tree and goes to the surface of the brain. The surface of the brain is gray due to the color of the cell bodies (that's why it's called the gray matter). The wires or axons have a coating on them that's colored white (called white matter).

The brain is divided in half, a right and left hemisphere. The right hemisphere does a different job than the left. The right hemisphere deals more with visual activities and plays a role in putting things together. For example, it takes visual information, puts it together, and says "*I recognize that--that's a chair*," or "*that's a car*" or "*that's a house*." It organizes or groups information together. The left hemisphere tends to be the more analytical part; it analyzes information collected by the right. It takes information from the right hemisphere and applies language to it. The right hemisphere "sees" a house, but the left hemisphere says, "*Oh yeah, I know whose house that is--it's Uncle Raja's house*."

So what happens if one side of the brain is injured? People who have an injury to the right side of the brain "don't put things together" and fail to process important information. As a result, they often develop a "denial syndrome" and say "there's nothing wrong with me." For example, I treated a person with an injury to the right side of the brain--specifically, the back part of the right brain that deals with visual information--and he lost half of his vision. Because the right side of the brain was injured, it failed to "collect" information, so the brain did not realize that something was missing. Essentially, this person was blind on one side but did not know it. The left side of the brain deals more with language and helps to analyze information given to the brain. If you injure the left side of the brain, you're aware that things aren't working (the right hemisphere is doing its job) but are unable to solve complex problems or do a complex activity. People with left hemisphere injuries tend to be more depressed, have more organizational problems, and have problems using language.

Rule-Based Approach for Knowledge Management

There’s an ongoing debate among neuroscientists, cognitive scientists, and even philosophers as to whether or not we could ever construct or reverse engineer the human brain. Interestingly, the two approaches come from two relatively different disciplines: cognitive science and neuroscience. One side wants to build a brain with code, while the other wants to recreate all the brain’s important functions by emulating it on a computer. It’s anyone’s guess at this point in time as to who will succeed and get there first, if either of them.

One very promising strategy for building brains is the rules-based approach. The basic idea is that scientists don’t need to mimic the human brain in its entirety. Instead, they just have to figure out how the “software” parts of the brain work; they need to figure out the algorithms of intelligence and the ways that they’re intricately intertwined. Consequently, it’s this approach that excites the cognitive scientists.

Some computer theorists insist that the rules-based approach will get us to the brain-making finish line first. Ben Goertzel is one such theorist. His basic argument is that other approaches over-complicate and muddle the issue. He likens the approach to building airplanes: we didn’t have to reverse engineer the bird to learn how to fly.

Essentially, cognitive scientists like Goertzel are confident that the hard-coding of artificial general intelligence (AGI) is a more elegant and direct approach. It’ll simply be a matter of identifying and developing the requisite algorithms sufficient for the emergence of the traits they’re looking for in an AGI. They define intelligence in this context as the ability to detect patterns in the world, including in itself.

To that end, Goertzel and other AI theorists have highlighted the importance of developing effective learning algorithms. A new mind comes into the world as a blank slate, they argue, and it spends years learning, developing, and evolving. Intelligence is subject to both genetic and epigenetic factors, and just as importantly, environmental factors. It is unreasonable, say the cognitive scientists, to presume that a brain could suddenly emerge and be full of intelligence and wisdom without any actual experience.

This is why Goertzel is working to create a “baby-like” artificial intelligence first, and then raise and train this AI baby in a simulated or virtual world such as Second Life to produce a more powerful intelligence. A fundamental assumption is that knowledge can be represented in a network whose nodes and links carry “probabilistic truth values” as well as “attention values,” with the attention values resembling the weights in a neural network. There are a number of algorithms that need to be developed in order to make the whole neural system work, argues Goertzel, the central one being a probabilistic inference engine and a custom version of evolutionary programming. Once these algorithms and associations are established, it’s just a matter of teaching the AI what it needs to know.

Knowledge Transfer to Brain

The processing of information by the brain is mainly based on the coding of data by variations in the frequency of neuronal activity. “Good” communication thus implies the reliable transmission of this “code” by the connections between neurons, or synapses. Under normal circumstances, this junction comprises a pre-synaptic element from which the information arises, and a post-synaptic element which receives it.

It is at this point that neuronal communication occurs. Once the pre-synaptic neuron has been stimulated by an electrical signal with a precise frequency, it releases chemical messengers into the synapse: neurotransmitters. And the response is rapid! These neurotransmitters bind to specific receptors, thus provoking a change to the electrical activity of the post-synaptic neuron and hence the birth of a new signal.

The mobility of receptors controls the reliability of neuronal transmission. Working at the interface between physics and biology, the teams in Bordeaux led by Choquet, CNRS senior researcher in the “Physiologie cellulaire de la synapse” laboratory, working in close collaboration with the group led by

Brahim Lounis at the Centre de physique moléculaire optique et hertzienne have been studying synaptic transmission and, more particularly, the role of certain receptors of glutamate, a neurotransmitter present in 80% of neurons in the brain.

Focusing on the dynamics of these receptors, the researchers have revealed that a minor modification to their mobility has a major impact on high frequency synaptic transmission, i.e. at frequencies between 50 and 100 Hz (those which intervene during memorization, learning or sensory stimulation processes). More specifically, they have established that this mobility enables the replacement in a few milliseconds of desensitized receptors by “naïve” receptors in the synapse. This phenomenon reduces synaptic depression and allows the neurons to transmit the information at a higher frequency. By contrast, if the receptors are immobilized, this depression is notably enhanced, preventing transmission of the nerve impulse in the synapses above around ten Hertz.

More profoundly, the scientists have demonstrated that prolonged series of high frequency stimulations, which induce an increase in calcium levels in the synapses, cause the immobilization of receptors. They have also proved that these series of stimulations diminish the ability of neurons to transmit an activity at high frequency. Receptor mobility is thus correlated with the frequency of synaptic transmission and consequently, the reliability of this transmission.

Conclusion

When the brain is functioning under normal conditions, we can suppose that the immobilization of receptors following a series of high frequency stimulations constitutes a safety mechanism. It will prevent subsequent series from overexciting the post-synaptic neuron. A reliable transmission of information between two neurons is obviously crucial to satisfactory functioning of the brain.

These results, of prime importance, suggest that some dysfunctions of neuronal transmission are due to a defect in receptor stabilization. However, high frequency electrical stimulation of certain regions of the brain is used to treat Parkinson's disease or obsessive-compulsive disorders (OCD). Its mechanism of action, still poorly understood, may therefore involve receptor mobility. This work has thus made it possible to identify new therapeutic targets and could augur well for potential drugs to treat neurological and psychiatric disorders which often result from poor communication between neurons.

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