Z Solutions®

SO YOU WANT TO TRY NEURAL NETS?

Z Solutions is in the business of helping organizations apply artificial neural networks. Neural networks are one of those "new" technologies that are touted as being able to revolutionize your understanding of data. The techniques are loosely inspired by biological learning and can be used to discover (learn) patterns not readily apparent in data. The techniques can be thought of as delivering a "little brain" that has learned much about your problem. Anyone reading popular business press these days reads about the term data mining. Neural Networks are one of the most powerful techniques used in this area. The learning algorithms of neural networks can probe through data and learn relationships not readily apparent otherwise -- the techniques deliver on their promise.

Published sources expound upon the power of these techniques to solve business problems. Leaving that reasonable topic aside, I will focus on an even more remarkable capability of the technology. Perhaps the most interesting facet of these little brains is their ability to shut down previously well functioning bigger brains. If you think Neural Networks can help you solve a sticky problem you are probably right. However, before starting, consider that you might benefit from our experience.

AVOID THE MAGIC PILL SYNDROME

I always wondered why every third utility pole as you drive down the street has a sign that says: "Lose weight, now. Let me show you how!" or "Earn $4,000 a week from home, no risk." I think I'm beginning to see why now. I have actually had people ask me, "we have no data and no history to learn from, can a Neural Network help me solve this problem?" Now I've got to tell you, after spending an hour and a half sweating over a detailed explanation of learning algorithms, the clever mathematics of a Neural Network and the general concept of learning for both humans and machines, such a question is disheartening. It is not at all surprising, but Artificial Neural Networks, like our biological neural networks, perform much better when there is something to learn. Maybe I should just take their money and sell them some sugar coated diet pills.

People are intrigued by the concept of Neural Networks. The idea of a mathematical technique that can learn using methods similar to the way we learn is fascinating. They hope the techniques can provide an answer where one was not apparent before. I am firmly convinced that Neural Network techniques can make many tasks easier and solve some problems that are not solvable otherwise. However, there is still a great deal of sweat involved.

This is our first example of the little brain controlling the big brain. Most of our clients recognize that in order to make a significant difference in a significantly difficult problem that a significant effort will be involved. (The magic pill will not make the weight go away without effort.) In some cases a multiple phase project may be in order, with each phase progressing to a well-defined conclusion. Even in these well organized projects the temptation is there to believe that some magic in Neural Networks is going to make a problem disappear.

MAYBE YOU DIDN'T LEARN ALL THIS IN KINDERGARTEN, BUT…

A few years ago Robert Fulghum wrote a nice little book called, All I Really Need to Know I Learned in Kindergarten. It is a nice little book with a very simple premise. Many of the answers to life's big problems were actually covered in kindergarten. You know, share, play fair, etc. My kindergarten education did not cover much in the way of analytical techniques, in fact my formal education didn't cover anything at all about Neural Networks. But similar to Mr. Fulghum, my basic education did give me a lot of useful information I can apply to using Neural Networks.

Although the techniques represent great advances in learning and data analysis capability, several basic principles from your educational background apply. For example, while studying literature we had essay questions such as, "Summarize the basic premise of the book, detailing..." If my memory is correct (I really guess it isn't) I got this question once a week. It took me a while, but I finally learned the best way to solve the problem is not to throw every random fact I can remember from the book on the paper. A much more structured approach to the essay question worked a whole lot better.

But guess what people do when given a neural network? As soon as the data is formatted and ready for the network's learning algorithm, they throw it all at it. Remember Peppermint Patty from Peanuts fame? She repeatedly throws out unrelated facts on her school papers. What grade does she receive? Yes, a "D minus". Do you know what grade a Neural Network would get from what it learns from such an approach. Yes, a "D minus". Yet another example of that little brain having an effect on the big brain.

A structured thoughtful approach to problem solving is as always the best approach. In our training classes that we provide and in our consulting assignments we stress repeatedly that 75% or more of your time in a Neural Network project is spent working with your data: understanding it, preparing it for the learning algorithm and just plain looking at it.

Back to my formal education. Whether it was a literature class, a physics class or a decision sciences class, (and probably kindergarten) the lesson was the same (although the wording would be different). Format and state your problem, define your research question or just plain determine what is important.

I regret to say it but we have had clients who can't wait to solve their problem using these nifty algorithms. Without a close inspection of the data they quickly apply it to the software and they develop a model that looks very nice. They have a graph that shows the model error is quite low -- meaning the network has learned the problem well. You can even tell which inputs are important. When you have such a model you can't resist showing it off. Finally it is time to apply the model to an important problem. The results are terrible. Suspicion and dread now loom over the project. All involved spend a great deal of time looking at the data and the problem. Pouring over graphs and descriptive statistics of the input data, the step we recommend as the first step, it is discovered that the data used to train the neural network does not cover the region (the bounds of minimums and maximums) where the network is applied. Basically, the network knows nothing about the problem you want to solve. There are technical terms to describe this state but in realistic terms, you might as well go to your doctor for landscaping advice.

THE ANSWER IS IN YOUR DATA AND YOUR HEAD

We have heard many stories where a Neural Network project was undertaken and it failed. And I am sure this is true of other technologies. The participants are still excited. They are certain that with new software (invariably due out next summer) and more powerful computers success is assured. This is better than the problems described

above. At least the big brain is in gear -- just looking in the wrong place. We like to say, *"The answers are in your data, not the learning algorithm."* All learning algorithms are not the same. Some are going to find some relationships others will not find. But as a general rule, working with your data and improving the data that the network sees is a much higher probability approach to solving your problem. Tell the network what you know. So let me rephrase the above emanation, *"The answers are in your data and your head, not the learning algorithm."*

What are you trying to accomplish with this data analysis? You need to tell the neural network algorithm what you know about the problem and let the network learn what else there is to see in the data. The reality is the network cannot learn all that you know. Specifically, the network cannot learn what is important. The problem design is the most important aspect of the project.

Additionally, if you are asking a learning algorithm to find out more about your problem than you already know, then the least you can do is provide some help. For example, if you are a financial analyst you know certain important financial ratios apply to your problem. If you are an engineer, you are aware of certain data relationships that are based on the physics of the problem. Calculate those relationships and feed them to the network. The network may learn them itself, but why make it difficult?

I believe this is true of all technologies. The technology itself does not solve problem. The technology is the tool used to implement the solution.

INERTIA

Even when the above concerns are well understood and dealt with there is still a problem when applying any new technology. You are dealing with change. Change is hard. In discussions with our clients and other colleagues we hear a recurring theme - new technologies can be difficult to implement. The participants appear willing but the technology doesn't get used. In his book, Sacred Cows Make the Best Burgers, Robert Kriegel presents four resistance drivers to change. They are:

Fear -- "What if ... I lose my job, look stupid, can't adapt," etc.

Feeling Powerless -- "No one asked me!"

Inertia -- "It's too much effort, too uncomfortable."

Absence of Self-Interest -- "What's in it for me?"

Of these four the most common we see is the inertia driver as the biggest impediment to the implementation of technology. To continue the physics analogy Mr. Kriegel has used, a force greater than the inertia has to be applied in order for there to be movement.

One of the key benefits of Neural Network solutions is their capacity to save time, an important consideration in today's business world. Because of the adaptive nature of the learning algorithms the approaches can solve problems faster than traditional techniques. Less time can be spent concerned with finding the correct functional forms. But this is after the techniques have been implemented, tested and applied to the specific problem. The big brain needs to prepare for the time and expense investments required to achieve the changes desired. An investment upfront is needed before the benefits should be expected.

IN CONCLUSION

We are at a loss to explain why otherwise very intelligent people approach their problems in such a way. These people have sharp analytical minds and good business sense. The answer is that it is easy to be lulled in by the power of Neural Networks or to hope for the blessings of technology in general. Our clients, be they industry or government, are dealing with a lot. Corporations have restructuring, downsized, budgets are being cut, markets are changing and relationships are breaking down. This is all occurring at a time when the amount of information pouring into organizations is increasing. Neural Networks are said to be easier. They are said to learn what is important on their own. This is all true, to a degree, but it is a false hope to expect this to happen without a significant and thoughtful commitment to apply the technology.

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REFERENCE

Kriegel, R., & Brandt, D., (1996). Sacred Cows Make the Best Burgers. Warner Books

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