THE HISTORY OF US PRESIDENTIAL ELECTIONS FROM SIBERIAN NC POINT OF VIEW

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Tests were performed with the program "US Presidential Elections" and the future relationship between neuro-computers and the human sciences was discussed.

1. Introduction

This paper will discuss the type of neurocomputer being developed in Krasnoyarsk (by S. E. Gilev, A. N. Gorban, E. M. Mirkes), describe the results of some experiments, and conclude with a discussion on possible future applications of neurocomputers in the human sciences.

The neurons and synapses which will be discussed in this paper are not actual physical objects, but rather they are theoretical mathematical entities. The neurocomputer itself is realized through a program which is run on a conventional IBM compatible computer. Thus the Krasnoyarsk neurocomputer is modeled on a conventional computer.

In order to clarify the meaning of the term "train" as applied to NC, consider a simple problem of pattern recognition, and compare the training of a neurocomputer with the training of a small child learning to speak. Suppose we have three simple pictures: an apple, a banana, and a pear, and the task is to recognize and identify each picture. One method of teaching the child may be to show him or her each picture one by one, ask what the picture is, and correct any mistakes. A similar process may occur in the NC where a built-in feature called "teacher" presents the network with the pictures, and upon receiving an answer will try to correct mistakes. The process will need to be repeated several times depending upon the complexity of the problem and the capability of the learner. This process of repeated presentation and correcting of mistakes is called "training".

There is one very important difference in the structure of this training process for a child and for the Krasnoyarsk NC. When the child makes a mistake, he is immediately corrected. However, the NC is corrected only after it has been shown each picture and responded. Here the teacher makes a correction of the summed error. This difference in training is what separates the Krasnoyarsk NC system from other systems, and may permit it to train tens of thousands of times faster in certain applications [1].

Another useful characteristic of the neurocomputer is that if it is not certain of an answer, it can tell the user the degree of its uncertainty. For instance whereas a child may simply reply that he is "pretty sure" that the picture is of an apple, the neurocomputers can tell you it is 82% sure.

The above example of training is quite simple, but useful, since the same basic process is used for much more complicated problems, for example, in trying to predict the outcome of U. S. presidential elections. In fact such a program has been created in Krasnoyarsk. After entering data of various elections in history, this program will make a prediction on the outcome of a given election, either real or hypothetical. This program consists of three main steps:

1) create a network to suit the problem

2) train the network

3) apply the network to a desired situation.

Creating a network, involves choosing such parameters as the number of neurons, the maximum and minimum values of the synapse connections and various other parameters related to the theoretical algorithm upon which the system is based [1]. Once the network is created, it is given a name and stored in the form of a matrix in the memory of the neurocomputer.

The next step is training. As mentioned before, the neurocomputer is self-training by means of a feature called "teacher". Before the teacher can begin training, however, the user must give the computer training information. The information given to the computer depends upon the goals of the user. In our experiments, we gave it information in the form of answers to questions about the political, economical, and social conditions of the country as well as some information about the candidates themselves [2]. Since in each election there are two main opponents, the candidate of the party currently in power (P-party) and the candidate of the main opposition party (O-party), the possible answers to these questions are "yes", "no", or "unknown". These questions are collected in the Table 1. The answers corresponding to the victories of the P-party are presented in the Table 2, while in the Table 3 we give the answers vor the victories of the O-party.

These answers for various elections are entered into the NC along with the name of the winning party. Next the teacher begins to train the network. Using a rather

TABLE 1. QUESTIONS

1) Has the P-party been in power for more than one term?
2) Did the P-party receive more than 50% of the popular vote in the last election?
3) Was there significant activity of a third party during the election year?
4) Was there serious competition in the P-party primaries?
5) Was the P-party candidate the president at the time of the election?
6) Was there a depression or recession in the election year?
7) Was there a growth in the gross national product of more than 2.1% in the year of the election?
8) Did the P-party president make any substantial political changes during his term?
9) Did significant social tension exist during the term of the P-party?
10) Was the P-party administration guilty of any serious mistakes or scandals?
11) Was the P-party candidate a national hero?
12) Was the O-party candidate a national hero?

TABLE 2. P-PARTY VICTORIES

Election No.	Year	1	2	3	4	5	6	7	8	9	10	11	12
p-1	1864	n	n	n	n	y	n	n	y	y	n	n	n
p-2	1868	y	y	n	n	n	n	y	y	y	n	y	n
p-3	1872	y	y	n	n	y	n	y	n	n	n	y	n
p-4	1880	y	n	n	y	n	n	y	y	n	n	n	n
p-5	1888	n	n	n	n	y	n	n	n	n	n	n	n
p-6	1900	n	y	n	n	y	n	y	n	n	n	n	y
p-7	1904	y	y	n	n	y	n	n	n	n	n	y	n
p-8	1908	y	y	n	n	n	n	n	y	n	n	n	y
p-9	1916	n	n	n	n	y	n	n	y	n	n	n	n
p-10	1924	n	y	y	n	y	n	y	y	n	y	n	n
p-11	1928	y	y	n	n	n	n	y	n	n	n	n	n
p-12	1936	n	y	n	n	y	y	y	y	n	n	y	n
p-13	1940	y	y	n	n	y	y	y	y	n	n	y	n
p-14	1944	y	y	n	n	y	n	y	y	n	n	y	n
p-15	1948	y	y	y	n	y	n	n	y	n	n	n	n
p-16	1956	n	y	n	n	y	n	n	n	n	n	y	n
p-17	1964	n	n	n	n	y	n	y	n	n	n	n	n
p-18	1972	n	n	n	n	y	n	y	y	y	n	n	n

Answers to Questions (columns 1–12)

TABLE 3. O-PARTY VICTORIES

Election No.	Year	1	2	3	4	5	6	7	8	9	10	11	12
o-1	1860	y	n	y	y	n	n	y	n	y	n	n	n
o-2	1876	y	y	n	y	n	y	n	n	n	y	n	n
o-3	1884	y	n	n	y	n	n	y	n	y	n	y	n
o-4	1892	n	n	y	n	y	n	n	y	y	n	n	y
o-5	1896	n	n	n	y	n	y	n	y	y	n	y	n
o-6	1912	y	y	y	y	y	n	y	n	n	n	n	n
o-7	1920	y	n	n	y	n	n	n	y	y	n	n	n
o-8	1932	y	y	n	n	y	y	n	n	y	n	n	y
o-9	1952	y	n	n	y	n	n	y	n	n	y	n	y
o-10	1960	y	y	n	n	n	y	n	n	n	n	n	y
o-11	1968	y	y	y	y	n	n	y	y	y	n	n	n
o-12	1976	y	y	n	y	y	n	n	n	n	y	n	n
o-13	1980	n	n	y	y	y	y	n	n	n	y	n	y

Answers to Questions (columns 1–12)

complicated algorithm [1], the teacher begins to adjust the synapses. When the optimal performance of the network is found, training step is finished. This process of training may take from 1-10 minutes (on an IBM PC/AT, 286-10) depending upon the characteristics of the network and the type of training.

The third and final step is to apply the network to a specific situation. This application differs from the example of pattern recognition given earlier in that a trained network is now presented with a situation that it has never before seen. Here a situation is created, either real or imaginary, by answering the 12 questions, and then the NC is asked who will win this election (the time necessary for this decision is on the order of .01 seconds).

Another useful capability of this program is that after training the network (with as much or as little information as desired for a given test), it is possible to find out the NC's opinion of the relative importance of each of the questions with respect to one another.

Having described the basic steps of operation, we will now turn our attention to the results of some tests that were carried out with this program. These tests have been chosen for two reasons. First, to demonstrate the prediction capabilities of the NC. Second, to demonstrate the NC's ability to find relationships that would not be possible to find without computers.

2. Test Results

TEST 1: Prediction capabilities of the Neurocomputer

The first test in this section was conducted in order to find the relationship between the number of elections used in the training process and the accuracy with which the NC is able to predict the remaining elections. As in all of the following experiments, we used the US presidential elections beginning with the election of 1860 and ending with the election of 1980.

The results are shown in figure 1. For each network the number of P-party and O-party elections used in training is equal. Therefore the first 6 elections used are not the 6 elections beginning with the 1860 election but the first three P-party victories beginning with 1860 and also the first 3 O-party victories.

A variant of this experiment was conducted in which we trained networks on later elections, and tested the NCs ability to "predict" earlier elections. These results are shown in figure 2.

The above tests, as well as tests presented in other sections, were performed with networks consisting of 16 neurons.

TEST 2: Evaluating of the Importance of Questions.

As stated earlier, after training a network it is possible to see on the display the networks evaluation of the relative importance of each question. First we trained a net using all elections from 1860 to 1980. The 4 most important questions according to the NC are, in decreasing order of importance:

1) Was there serious competition in the P-party primaries? (yes, bad for P-party)

2) Did significant social tension exist during the P-party's previous term? (yes-bad for P-party)

3) Was there a growth in the gross national product more than 2.1% in the election year? (yes-good for P-party)

4) Did the P-party president make any substantial political changes during his term? (yes-good for P-party)

Using only these four questions we repeated in part TEST 1 and the results are shown in figure 3.

TEST 3: Election "Underdogs"

Another interesting result of these experiments is that the computer consistently had trouble predicting certain elections. We call the Presidents who beat the odds "underdog" Presidents. Furthermore, it was noticed that there were underdogs of varying degrees; for some elections the NC occasionally erred (slight underdogs) while for others it almost always erred (strong underdogs). There was a group of three presidents who were much stronger underdogs than any of the others, they were, in decreasing order of strength, the winners of the elections of. 1892, 1880, and 1896 (O-4, P-4, O-5).

TEST 4: "Tradition" of the First Two Elections and their opponents

The final experiment that will be presented in this section was conducted as an example of how one might search for a new type of relationship, pattern, or tradition. Such a search could be performed in countless ways. We began by training a network with the first two elections. We then tested the network's ability to predict the remaining elections. Noting all the elections which were correctly predicted, we then used these as well as the original two elections and retrained the network. This process was repeated until the network could no longer correctly predict any of the remaining elections.

For example, in one such experiment after training a network with the first two elections it was then able to correctly predict all remaining elections except for the elections of 1880, 1892, 1896, 1920, 1928, 1932, 1960. Next, we trained the same network using all the elections except those mentioned above. After this we noted that the network could then also predict correctly the election of 1880, so we trained it again, but no further improvements were noted.

This experiment was repeated several times, each time with a separate group of incorrectly predicted Presidents remaining at the end. Although these groups were different, there was a core of four presidents who occurred in each group they were those who were elected in 1892, 1896, 1928, 1932 (p-11, o-4, o-5, o-8).

A variant of this experiment was performed in which rather than beginning with the first two presidents, we began with the group of four presidents in the above paragraph. Again we found a core of presidents who were incorrectly predicted each time: p-1, p-18, o-1, o-2, o-3, o-6, o-9, o-11, o-12. as well as a group who was correctly predicted each time: p-6, p-7, p-10, p-12, p-13, p-14, p-16.

3. Discussion of Results

The above section describes a few of the possible tests that may be explored with the Program "US Presidential Elections." These tests were not chosen to answer any specific question, but rather to demonstrate the prediction capabilities of the computer (tests 1 and 2), and also to show how the NC might find new relationships and tendencies and use them to analyze a situation (tests 2, 3, and 4). In this sense, the NC actually has a sort of "intuition"; it is given a large amount of information, and, without understanding the processes which control the situation, it is able to give its opinion of the situation's outcome.

During these tests we also found at times that the NC generated more questions than it answered. Some of these questions, although possibly interesting to computer programmers, would best be answered by historians. For example, a question naturally arises when examining the results of TEST 1 (figures 1 and 2): Why is it easier for the NC to predict later elections after being trained on earlier elections than it to predict earlier elections after being trained on later elections? Possibly the answer to this question involves the very development of traditions or perhaps the answer is more

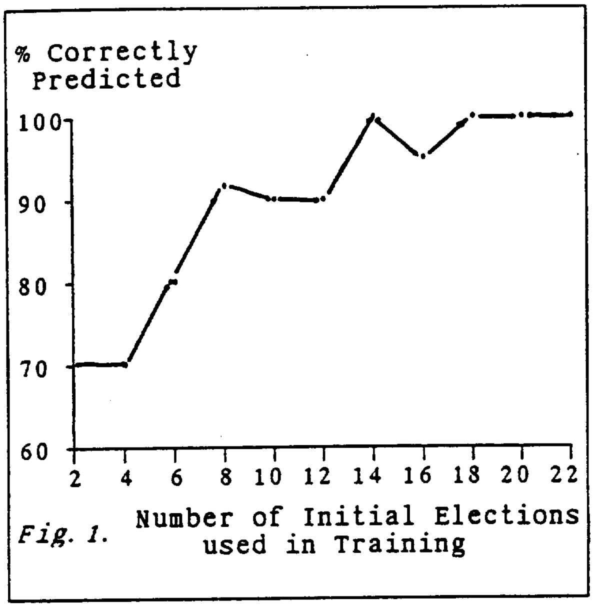

Fig. 1.

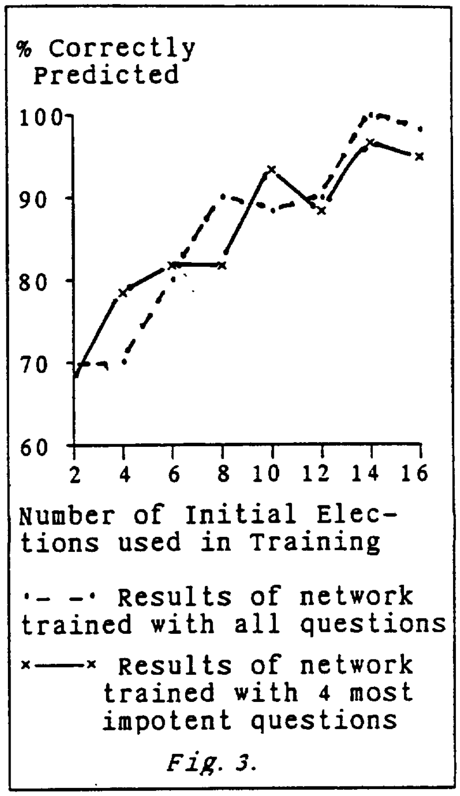

Fig. 3.

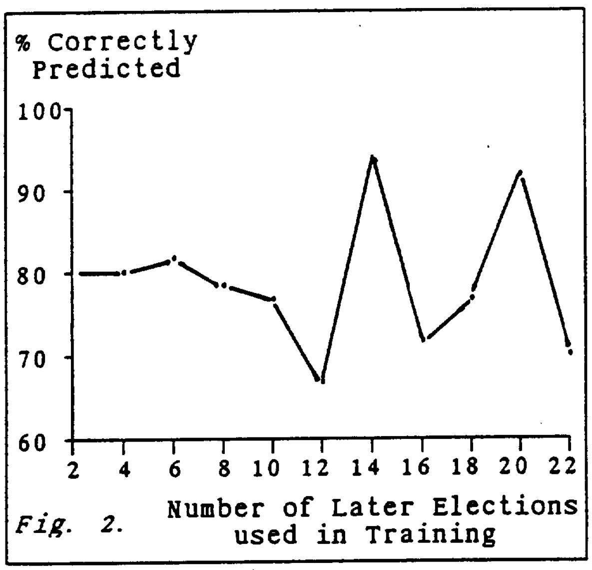

Fig. 2.

Figure 1. % Accuracy Vs. Number of Initial Elections Used in Training

Figure 2. % Accuracy Vs. Number of Later Elections Used in Training

Figure 3. Training With 4 Most Important Questions

closely connected to the choice of questions used. Other questions concern the appearance of underdog presidents: What made these elections difficult for the NC to predict? And what conditions existed at the time which enabled these presidents to "beat the odds" as calculated by the NC? Finally, many questions arise when trying to interpret the results of test 4: In what sense is this experiment finding traditions?, or hidden relationships?, what is the relationship between the two variants of this experiment?

From these tests, results, and the above questions, we begin to see the possibilities for an entirely new class of neurocomputer applications. For instance, it might be quite interesting for a historian to ask a computer "What if...?"; What if a historical situation had been a bit different some time in the past, what might have been the result?

Test 3 displayed another useful application of neurocomputers. Here we saw the NC evaluate a list of questions designed by experts. The NC's ability to quantify its "opinion" of the importance of various questions could be extremely valuable in many fields when processing answers of surveys or trying to formulate the most useful set of questions.

Perhaps the most obvious application is to train a network using all available and pertinent information, and then to forecast an upcoming election. Undoubtedly, this has been done many times by both political parties , but probably not using the unique advantages that NC's might offer. For example, suppose that you wanted to run for president in 1992. Before spending millions of dollars on your campaign, it might be worth your while to gather information of past elections, and then pose the question of your chances for success to an unbiased computer. Furthermore you might see what changes in the current situation might improve your chances Such questions about "what changes might cause what result" are not new, answering them quantitatively is new.

4. Conclusion

Perhaps the most revolutionary aspect of neurocomputers is that they can be applied to problems of which we have very little understanding. This is quite different than the standard use of computers in science. Often scientists apply computers to algorithmic problems (in which the problem can be solved by a defined series of steps). For such problems traditional computers are of tremendous value, and can work thousands of times faster than humans. But there is another area of science where the exact nature or form of the problem is rarely well understood - the human sciences. In History, Political Science, Psychology, and Education sciences there are many possible applications of NC's. We have already discussed some direct applications in history and political science. We also saw how new questions might be formed in the course of these applications. This ability to find new questions should not be overlooked as it has been said that sometimes the question is much more important than the answer.

5. References

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