NEURAL NETWORKS IN PSYCHOLOGY: CLASSICAL EXPLICIT DIAGNOSES

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ABSTRACT. The purpose of this work is to employ trainable neural networks to start solving the problem facing the designers and users of computer psychological tests:

Cultural, national and social adaptation of tests. Mathematical construction of up-to-date objective diagnostic tests is based on comparison, of revealed condition with the norm, standard [3]. It is understandable that the norms worked out for one socio-cultural group are not necessarily such for an other. By way of example it is possible to cite the difficulties to be reckoned with in adapting foreign techniques. Neural networks were successfully used for classical explicit diagnoses. The typical experiment is described.

NEURAL NETWORK

A neural network is a system of non-linear functional transformers for example $f=x/(c+|x|)$, where f is the output signal, x is the input signal and c is the characteristic of the transformer), connected by linear (of the form of $f=Wx$, where f is the transformed value, W is the weight of connection, x is the input value) connections - synapses. Neurons can be connected in different

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patterns. We used full-connected networks (when a signal from each neuron is delivered to each neuron). The input of each neuron is delivered weighted sum of all signals transmitted to it.

A family of training algorithms has been substantiated theoretically (see [1]) for such a pattern. The training is reduced to minimization of the error function H for a set of standard examples (pairs of the form (X, Y), where X is the input signal vector, Y is the output signal vector of the network). Minimization is done by changing the adjusting parameters (in this case they are the synapse weights W). The training is considered complete if to standard inputs from the training sampling the neural network delivers standard outputs with prescribed accuracy. Having successfully mastered the training sampling the results of training are verified by testing with a number of new examples (not included into the training sampling).

The study was done by neural software of NeuroComp group [5] on psychological material collected at the Krasnoyarsk Military Hospital and among the students of Krasnoyarsk Technological Academy.

Below are the results of two typical experiments.

EXPERIMENT: Processing results of classical testing

The aim of this experiment was to evaluate the adequacy with which a neural network simulator is capable of reproducing the results of a typical psychological technique to diagnose a patient. Can a neural network learn to make a classical diagnosis on the basis of raw material. For raw material we considered answers to the questions of a standard test.

The experiment used PQBI (Personality Questionnaire of Bekhterev Institute) psychological technique [6] widely used in clinical practice.

CLANAss neural simulator was used. CLANAss software package is neurocomputer software simulator realized on IBM PC/AT and designed to solve classification problems. This software package allows to create and train the neural network to use a set of input signals (answers to given questions, for example) to identify affiliation of an object to one of n (n<10) classes below numerated by integers from 1 to n.

The sampling required for training was made of examinations by PQBI technique of 35 conscripts and servicemen undergoing treatment at Krasnoyarsk garrison medical hospital.

Each person examined was given a vector of 162 answers from PQBI questionnaire. Coordinates of this vector are +1 or -1 (-1 - question is not chosen, 1 - question is chosen). A classifier network was constructed for each psychological type. It should classify the persons examined into two classes: 1 class - the type is absent, 2 class - the type is diagnosed.

CLANAss set of problems was made of 9 files - one for each of the following 9 types: anosognostic, apathetic, egocentric, euphoric, hypochondric, melancholic, neurastenic, paranoidal, sensetivous (PQBI questionnaire makes possible to distinguish several more types, but the training samplings lacked sufficient data for them).

Initially 9 networks were trained with the made sets of problems. For the base model we took the 16-neuron network. The response time (the number of network tacts from getting the input signals and yielding the results) was taken to be 10.

When testing the trained networks the percent of correct determination of new examples (absent in the training sampling) was about 60% of the given.

To improve recognition a paradoxical, at first sight, way has been chosen - to use the neural network with 2 neurons with input weight adaptive matrix (Fig. 1).

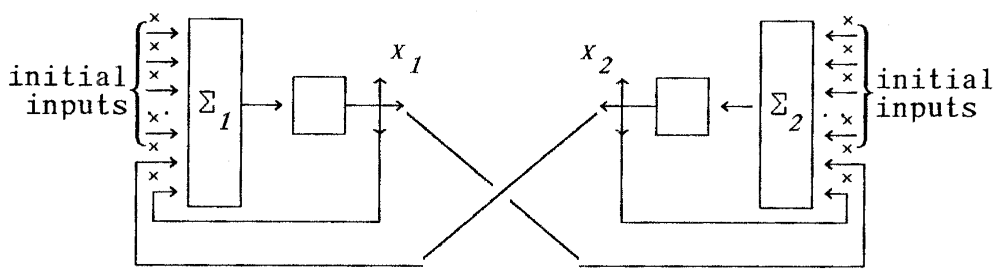

Fig. 1. Layout of the two-neuron expert. The symbol × shows that the input signals are multiplied with the input's weights.

The obtained results was even more astonishing. Operation reliability (per cent of correctly recognized new test examples) was more than 95%. Only one test example was not solved. It was the mistake of the network that was to identify absence or presence of an apathetic type. Apathy was absent in the example, and the network made the diagnosis "presence of apathetic type". The only reasonable explanation of this situation is that most examined persons (mostly they are conscripts) are psychologically inclined to the presence of this type. Most probably, the service conditions do not help reduce this tendency. Therefore, examples with apathetic type ABSENCE were insufficient to form the synapse weights capable of recognizing this situation with sufficient reliability.

Small networks generalize better (if one manages to train them). This can be explained by the fact that a larger size network can "memorize" more examples. It can, at this, reproduce these examples, but it generalizes worse. This is the reason for the smaller network having no resources to "memorize" examples, will have to learn to generalize.

So: the neural network simulators (and consequently, the neural networks as such) make possible to make psychological diagnoses. Special attention should be paid to compiling the training sampling. Its composition is crucial for the quality of the trained network.

Positive solution of this question opens broad prospects for developing adaptive psychological techniques. The possibility of additionally training a network minimizes the expenditures to adapt the tests; suffice is to choose examples of diagnoses not coinciding with the previous experience and perform additional training.

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