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SIMULATION OF HUMAN HEDONIC CHOICES

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Abstract

Neural networks are able to learn structures by using typical examples of this structure as input, without necessarily knowing the rules of it, even if the data are fuzzy (Rumelhart, D.E. & McClelland, J.L.1986). Human like/dislike choices are the result of complex perceptions whose components are not known or quantifiable in their importance in decision making: this is the case for example when tasting foodstuffs (Frijters, J.E.R., 1988). Using neural networks we have simulated a human subjective choice of taste employing as input chemical data and as output the taster's choice of a Panel test about the quality of wines and oils. The nets, after training cycles with a few examples, were able to give responses to the quality of all samples with little percentage judgement difference compared to each taster and related to the average Panel's judgement. The nets worked out sets of weights that give out new information showing and quantifying the relevance of each set of input data for the individual taster's choice.

1 Introduction

Several tests have shown the particular ability of the nets, in comparison with normal algorithms, in simulating human perception (Churchland, P.S. & Sejnowski, T.J., 1992). The most researched field is that of visual cognition, where the computer should be able to recognize an object when there is a lack of information about its definition or if the bounds of it are not geometrically described (Lisberger, S.G. & Sejnowski, T.J.,1992). In a hedonic choice the computer can make a further perception step: on the basis of an already known perception, that is, of a classification already having occurred, the net should be able to work out a judgement of taste for each specific similar perception, at least saying whether the object is a good or a bad one.

The chemical analysis of foodstuffs alone generally doesn't allow inductive judgements about the individual taster's choice. The analysis performed by the sense evaluates those qualities that are not provided by the chemical analysis, even the most advanced, probably because the compound of sense information produced by the nervous system allows us to perceive those relations between sensations that are insignificant if considered separately (Wold,S. et al., 1983). Furthermore, the simulation of individual taste choices has not been sufficiently researched in AI, whereas the importance of such individual preferences is well known in decision making (Slovic, P., 1990).

The advantages of such applications are to be seen in an improvement of evaluation criteria

of goods based on an increased objectivity of judgement. The computer in fact is not affected by those influences (i.e. tiredness, prejudice etc.) that can create errors in evaluation. Another advantage comes from the possibility of a standardization of judgement evaluation, because computers allow a better control of the experimental conditions and therefore a higher repeatability. This is especially true if we consider that the Panel test is now a fundamental criterion, at least in the European Community, for the trademark attribution of certain goods, as for example in the case of oil when attributing the ''extra virgin olive oil''. trade mark (Regulation EC,1987).

2 Model Description

Representative samples of wines (n°150) and olive oils (n°67) were submitted to net judgement using analytical data produced by official analysis methods. The analytical parameters we chose were for wines: Density, Alcoholic degree, Total alcoholic degree, Total reductor sugar, Dry extract, Total acidity, Volatile acidity, Ph, Ash, Total sulphur dioxide, Free sulphur dioxide, Methyl alcohol; for oils: Acidity, Polyphenols, Peroxides, $UV = K_{270}$ and $\Delta K = K_{268} - \left[\frac{(K_{262} + K_{274})}{2}\right]$

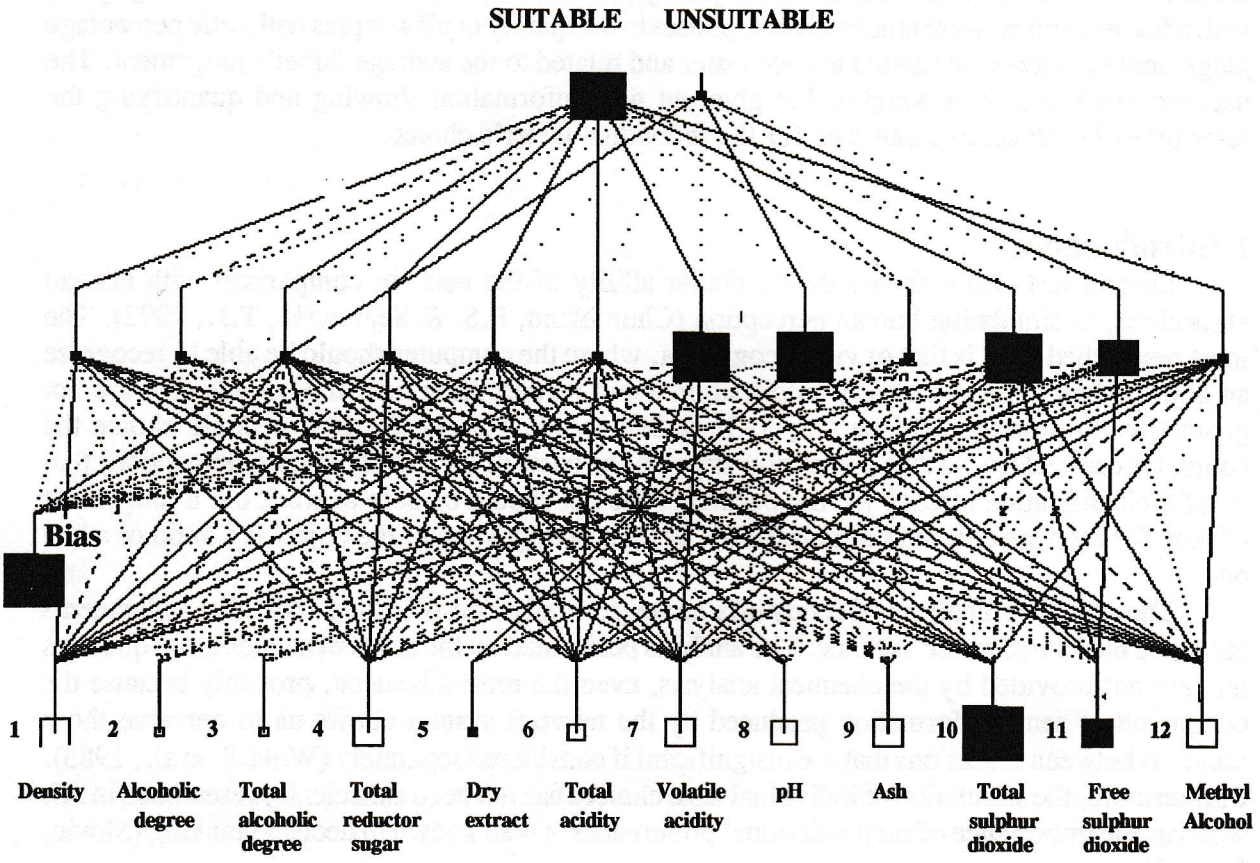

FIGURE 1: Structure of the neural network judging the suitability of a wine for the quality trademark. The 12 input units represent the chemical analisys of the wine, the two output units give out the suitability for the quality trade mark. The net is able to judge with a difference of 20% compared with the average judgements of a Panel, but with a percentage slightly over the one given by each Panel member.

The same samples were submitted to a Panel test. The wine net was made up of 12 nodes in input, 12 hidden and 2 nodes in output; and the net for oil of 5 nodes in input, 5 hidden and 1 node in output. The input data were given by the analytical values that have previously been indicated. The output data show a comparison with the judgements of the Panel of tasters and indicate whether that sample of wine or oil is suitable for the quality trademark.

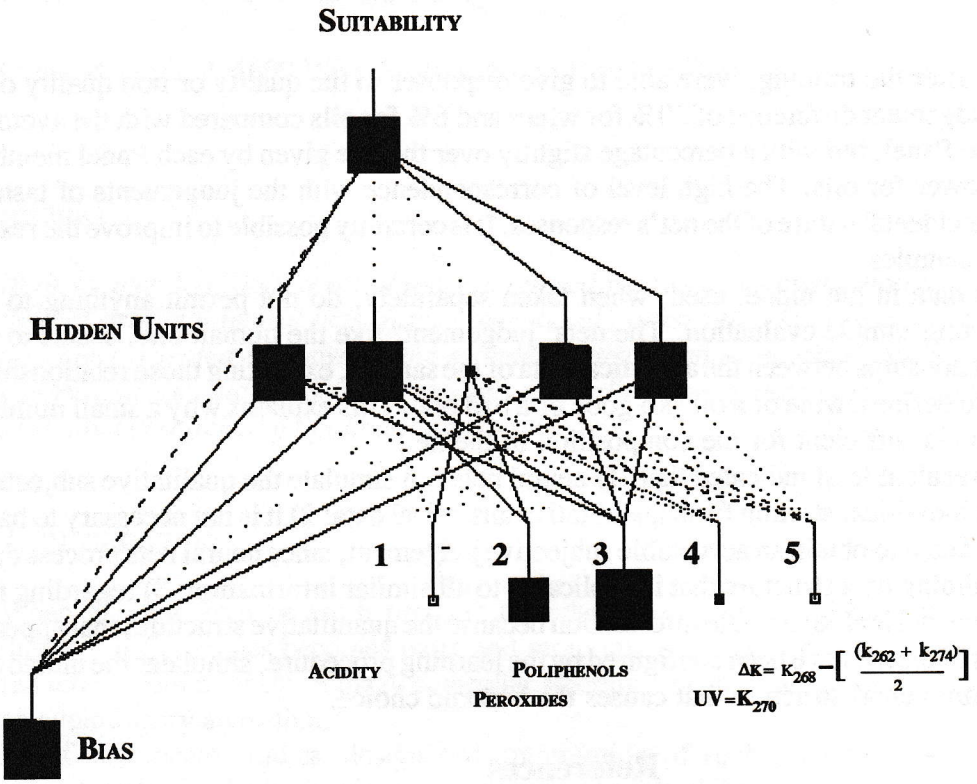

FIGURE 2: Structure of the network judging the suitability of a oil for the "extra virgin olive oil" trade mark. The net is able to judge with a difference of 6% compared with the average judgements of a Panel, but with a lower percentage compared to the one given by each Panel member.

The nets were trained through a set of 10 prototypical samples for the wines and 20 for the oils, with the back- propagation procedure using the 'delta rule' and sigmoid functions for 1,000,000 cycles.

Regarding wines, for the hedonic choice the net considers the following data important: Free sulphur dioxide, Total sulphur dioxide, Ash, pH. It is interesting to note that in commodity science a number of studies have attempted to show the existence of these correlations without however reaching an acceptable conclusion. Because this induction by the net of the principal components of the subjective judgement of a wine is interesting, we therefore tried to reproduce it in the field of olive oils where such correlations were in part already known.

The data that the net considers important for the subjective evaluation of oils are the polyphenols content and the value of peroxides. It is known that the polyphenols, natural anti-oxidants, preserve the aroma of the oils (Maga, J.A. 1978), while the peroxides are an index of the oxidation of the oils. It is interesting to note that this relationship is so reinforced in the net, that the cases in which the net was further from the taster's judgements are cases of oils in which the polyphenols and the peroxides gave a judgement that was opposite to the actual Panel one.

3 Discussion

The nets, after the training, were able to give responses to the quality or non quality of a sample with a judgement difference of 20% for wines and 6% for oils compared with the average judgement of the Panel, but with a percentage slightly over the one given by each Panel member for wines and lower for oils. The high level of correspondence with the judgements of tasters shows the non-accidental nature of the net's responses. It is certainly possible to improve the result by using larger samples.

The input data in the model used, when taken separately, do not permit anything to be inferred concerning sample evaluation. The nets' judgement, like the human one, seems to be based on the relationships between the analytical data of the sample, extracting those relationships that allow man to define a wine or a oil as a good or a bad one. This explains why a small number of analytical data is sufficient for the composition of the net.

This first result at least indicated that: 1) neural nets can simulate the qualitative subjective judgement of an individual starting from quantitative analytical data; 2) it is not necessary to have a large amount of data to obtain an acceptable subjective judgement, since neural nets process data analogically, building up a structure that is applicable to all similar information; 3) regarding the first point, a neural net is able to create information because the quantitative structure, that appears after the weights of the net have been configured by the learning procedure, simulates the unknown part of the human mental structure that causes the hedonic choice.

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