Classification of Jade with Fuzzy Bayesian Decision Making Method

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Abstract

Decision-making problems meet in the daily life or working environment. Sometimes it is very difficult to make the good decision. In practice, decision maker usually use the past experiences to make a decision. Selecting the best decision is one of the critical tasks in decision making process. This paper will implement the classification of jade upon chemical composition. This system will use the fuzzy bayesian decision method to predict the jade properties (Absence or Presence) based on the conditional probabilities of chemical compounds. The aim of this paper is to solve fuzzy bayesian decision making in decision making problem and to predict unknown class label according to the user input data record value.

1. Introduction

Jade is a gemstone of unique symbolic energy, and unique in the myths that surround it. With its beauty and wide-ranging expressiveness, jade has held a special attraction for mankind for thousands of years.

This gem, with its discreet yet rather greasy lustre, which comes in many fine nuances of green, but also in shades of white, grey, black, yellow, and orange and in delicate violet tones, has been known to Man for some 7000 years. In prehistoric times, however, it was esteemed rather more for its toughness, which made it an ideal material for weapons and tools. Yet as early as 3000 B.C. jade was known in China as 'yu', the 'royal gem'. In the long history of the art and culture of the enormous Chinese empire, jade has always had a very special significance, roughly comparable with that of gold and diamonds in the West. Jade was used not only for the finest objects and cult figures, but also in grave furnishings for high-ranking members of the imperial family [5].

Today, too, this gem is regarded as a symbol of the good, the beautiful and the precious. It embodies the Confucian virtues of wisdom, justice, compassion, modesty and courage, yet it also symbolises the female-erotic. A visit to the jade market is in Hong Kong or Rangoon, or at one of the Hong Kong jade auctions organised by Christie's, can give some idea of the significance this gem has for the people of Asia.

However, as long ago as the pre-Columbian period, the Mayas, Aztecs and Olmecs of Central America also honoured and esteemed jade more highly than gold. New Zealand's Maoris began carving weapons and cult instruments from native jade in early times, a tradition which has continued to the present day. In ancient Egypt, jade was admired as the stone of love, inner peace, harmony and balance. In other regions and cultures too, jade was regarded as a lucky or protective stone; yet it had nowhere near the significance that it had in Asia, which was presumably due to the fact that people knew relatively little about this fascinating gem.

Fortunately however, in recent times, people's understanding of this gem, which fascinates not only the connoisseurs by its perfect interplay of hardness and toughness with an enchanting range of colours and fine lustre, has improved; and their esteem for it has been on the increase all over the world [6].

This system focuses on the Fuzzy Bayesian approach to solve decision making problems. Decision problems called multiple objective decisions (MODs). This class of problems often involves many vague and ambiguous (and thus fuzzy) goals and constraints. The objective of the fuzzy decision methodology is to obtain a decision, optimum in the sense that some set of goals is attained while observing (i.e. not violating) a simultaneous set of constraints. This system developed one possible Fuzzy Bayesian Decision-Making Model and proved to be useful to decision makers in many "real-world" problems.

Jade of chemical composition is NaAl (Si_2O_6). It consists Sodium oxide, Aluminium oxide, Silicon dioxide, Calcium oxide, Magnesium oxide, Manganese oxide, Ferric iron oxide, Ferrous iron oxide, Chromium oxide, Titanium oxide and Potassium oxide. This system classified depending on chemical compounds of jade with fuzzy bayesian method. If chemical quality of jade contain little, it can be defined Absence. If chemical quality of jade is large, it can be defined Presence.

2. Related work

In 1996, Chenglin Peng et al. had applied Bayes' theorem to medical expert systems. They have expressed that Bayes' method is incapable of giving a proper solution to the following two open problems. Bayes' method does not do well in processing the common situation where the manifestation has a low frequency but a high specificity. The use of Bayes' theorem in analysis system is difficulty of obtaining realistic probabilities. So to solve these problems use a new modified fuzzy Bayes' method to the classification and prediction system. Using this new method, W.B. Vasantha Kandasamy and S.Devakumar discussed to study and find a solution to common situation when a manifestation has a low frequency but a high specificity. If a patient suffers from more than one disease at a time they by simultaneous use of fuzzy measure and fuzzy Bayes' theorem arrive at a proper conclusion. Hence by their new modified Bayes' method they have obtained a solution to both the problems proposed by Chenglin Peng et al[4].

J. Han and M. Kamber discudded the concepts of data mining. Data Mining (DM) is an essential tool in the pursuit of enhanced productivity, reduced uncertainty, delighted customers, mitigated risk, maximized returns, refined processes and optimally allocated resources. DM is defined as the process of discovering patterns in data. The process must be automatic or semiautomatic. The patterns discovered must be meaningful in that they lead to some advantages, usually an economic advantage. The data is always present in substantial quantities. Machine learning provides the technical basis of DM. The main ideas behind DM are often completely opposite to mainstream statistics [1].

3. Background Theory

3.1. Decision making

Decision making is a most important scientific, social, and economis enfeavor. To be able to make consistent and correct choices is the essence of any decision process imbued with uncertainty.

When dealing with decision making under uncertainty that there is a distinct difference between a good decision and a good outcome. In any decision process the information about an issue or outcome and choose among two or more alternatives for subsequent action. The information affecting the issue is likely incomplete or uncertain; hence, the outcomes are uncertain, irrespective of the decision made or the alternative chosen. To make a good decision and the outcome can be adverse. Alternatively, can make a bad decision, and the outcome can be advantageous. Such are the vagaries of uncertain events. But in the long run, if the consistently make good decision, advantageous situations will occur more frequently than bad ones.

To illustrate this notion, consider the choice of whether to take an umbrella on a cloudy, dark morning. As a simple binary matter, the outcomes can be rain or no rain. Two alternatives: take an umbrella, or do not. The information considered in making this decision could be as unsophisticated as own feelings about the weather on similar days in the past or as sophisticated as a large-scale meteorological analysis from the national weather service. Whatever the source of information, it will be associated with some degree of uncertainty. Suppose the decision to take the umbrella after weighing all the information and it does not rain. Eight times out of 10 in circumstances just like this one, it probably rained. This particular occasion may have been one of the two out of 10 situations when it did not [2].

3.2. Decision making with fuzzy information

Despite formal training in this area and common sense about how clear this notion of uncertainty is, it violated every day in the business world.

The best can do is to make consistently rational decisions every time are faced with a choice with the knowledge that in the long run "goods" will outweigh the "bads."

The problem in making decision under uncertainty is that the bulk of the information have about the possible outcomes, about the value of new information, about the way the conditions change with time(dynamic), about the utility of each outcome-action pair, and about preferences for each action is typically vague, ambiguous, and otherwise fuzzy. In some situations the information may be robust enough so that it can be characterized with probability theory.

In making informed and rational decisions must remember that individuals are essentially risk averse. When the consequences of an action might result in serious injury, death, economic ruin, or some other dreaded event, humans do not make decisions consistent with rational utility theory. In fact, studies in cognitive psychology show that rationality is a rather weak hypothesis in decision making, easily refuted and therefore not always useful as an axiomatic explanation of the theory of decision making. Human risk preference in the face of high uncertainty is not easily modeled by its rational methods. In a narrow context of decision making, rational behavior is defined in terms of decision making which maximizes expected utility. Of course, this utility is a function of personal preferences of the decision maker [3].

3.3. Fuzzy-based decision making approach

In today's fast-paced competitive market, the ability to launch a new product better and faster becomes a fundamental prerequisite for each company to stay in competition. Developing a new product that will be successful in the market requires a series of right decisions early at the design stage.

One of decisions that need to be correctly made during the design stage is selecting the best product concept that is worth developing.

Product concept selection belongs to multi criteria decision-making (MCDM) problems. In MCDM problems, a decision maker has to pick the best concept among a set of alternatives or product concepts based on a set of criteria or attributes. Comparing alternatives or product concepts to one another and ranking them are the pivotal roles in making the decision in such cases. Product concept selection during product development process is an iterative process that narrows the number of concepts quickly and selects the best concept.

Decision makers can assign the relative weight of decision criteria and evaluate each alternative with respect to each selection criterion. However, in case of conflicting alternatives, the task of picking the best concept becomes extremely difficult due to the imprecise or ambiguous data, which is norm in this type of decision problems. Therefore, a approach is required to perform product concept selection in product development process. The new approach should be robust enough for handling impreciseness of the product concept at the preliminary design stage. During product development process, decision makers often deal with objects that are difficult to describe. In the absence of complete and precise information, the fuzzy set theory becomes an effective tool for modeling complex systems [3].

3.4. Fuzzy models for classification

Modern information management systems enable the recording and the management of data using sophisticated data models and a rich set of management tools. In the context of classification systems, the information typically includes details about learning material, the tasks and the objectives, the attributes information, the contact information and other records. When perceived in the technical terms of the underlying information system, it soon becomes very difficult to manage, integrate, and access different kinds of information. It seeks means to model the imprecision of information and simplify the access to information systems, in terms of fuzzy modeling.

Computer-based learning management systems seek to be equivalent, if not superior, to the traditional learning systems. However, an increased technological potential does not automatically mean better applications. For instance, while the standardization of the application interfaces certainly improves the development of learning systems, and it is possible to semantically integrate different sources of information, by using standard general-purpose query languages the engagement with the technical details may be itself become an obstacle the prediction applications based on domain-specific design [3].

3.5. Fuzzy bayesian decision method

Classical Bayesian decision methods presume that future states of nature can be characterized as probability events. The following material first presents Bayesian decision making and then starts to consider ambiguity in the value of new information, in the states of nature, and in the alternatives in the decision process.

First consider the formation of probabilistic decision analysis.

Let $S = \{s_1, s_2, \ldots, s_n\}$

be a set of possible states of nature; and the probabilities that these states

$P = \{p(s_1), p(s_2), \ldots, p(s_n)\}$

where $\sum_{i=1}^{n} p(s_i) = 1$

The probabilities expressed are called “prior probabilities” in Bayesian jargon because they express prior knowledge about the true states of nature. Assume that the decision maker can choose among m alternatives,

$A = \{a_1, a_2, \ldots, a_m\}$.

And for a given alternative a_j, assign a utility value, u_{ji}, if the future state of nature turns out to be state s_i. These utility values should be determined by the decision maker since they express value, or cost, for each alternative-state pair, i.e., for each a_j - s_i combination. The utility values are usually arranged in a matrix in a matrix of the form shown in Table . 1. The expected utility associated with the j_{th} alternative would be

$$E(u_i) = \sum_{i=1}^{n} u_{ji}\, p(s_i) \cdot$$

The most common decision criterion is the maximum expected utility among all the alternatives,

$$E(u^*) = \max_{j} E(u_j)$$

Which leads to the selection of alternative a_k

$u^* = E(u_k)$.

Table 1.Utility matrix

states s_i action a_j	s_1	s_2	…	s_n
a_1	u_{11}	u_{12}	…	u_{1n}
. .	. .	. .	… …	. .
a_m	u_{m1}	u_{m2}	…	u_{mn}

3.5.1 Decision tree for state problem

In many decision situations an intermediate issue arises, should get more information about the true states of nature prior to deciding. Suppose some new information regarding the true states of nature S is available from r experiments or other observation and is collected in a data vector,

$X=\{x_1, x_2, \ldots.x_r\}$.

This information can be used in the Bayesian approach to update the prior probabilities, $p(s_i)$, in the following manner. First, the new information is expressed in the form of conditional probabilities, where the probability of each piece of data, x_k, where k=1,2,….r, is assessed according to whether the true state of nature, s_i, is known (not uncertain); these probabilities are presumptions of the future because the are equivalent to the following statement: the true state of nature is s_i, the probability that the piece of new information x_k confirms that the true state is s_i is $p(x_k \mid s_i)$.

These conditional probabilities, denoted $p(x_k \mid s_i)$, are also called likelihood values. The likelihood values are then used as weight on the previous information, the prior probabilities $p(s_i)$, to find update probabilities, known as posterior probabilities, denoted $p(s_i \mid x_k)$. The posterior probabilities are equivalent to this statement: the piece of new information x_k is true, the probability that the true state of nature is s_i is $p(s_i \mid x_k)$. These updated probabilities are determined by Bayes's rule,

$$p(s_i \mid x_k) = \frac{p(x_k \mid s_i)}{p(x_k)}\, p(s_i)$$

Where the term in the denominator, *$p(x_k)$*, is the marginal probability of the data *x_k* and is determined using the total probability theorem

$$P(x_k) = \sum_{i=1}^{n} p(x_k \mid s_i).\, p(s_i)$$

The expected utility for the *j_{th}* alternative, given the data *x_k*, is determined from the posterior probabilities (instead of the priors),

$$E(u_j \mid x_k) = \sum_{i=1}^{n} u_{ji}\, p(s_i \mid x_k)$$

and the maximum expected utility, given the new data *x_k*, is now given by

$$E(u^* \mid x_k) = \max_j E(u_j \mid x_k)$$

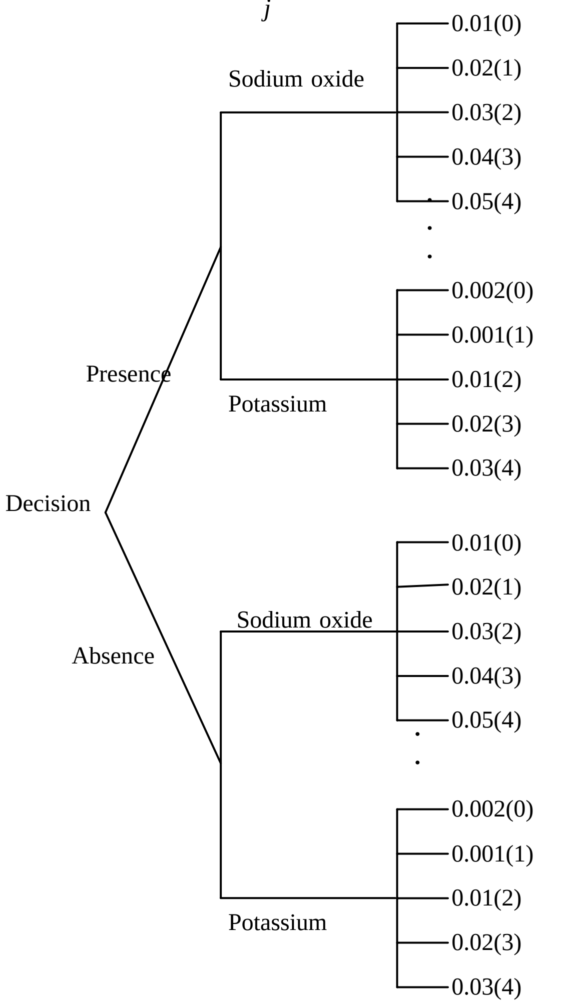

Figure 1. Decision tree for classification of jade

4. Proposed System Design

The details of the system design of the implementation are first modified training dataset of jade from database and they classify with Fuzzy Bayesian Method. Then user must choose his requirements of jade dataset. And then this system predicts result and conditional probabilities, and finally, displays the result of jade classification.

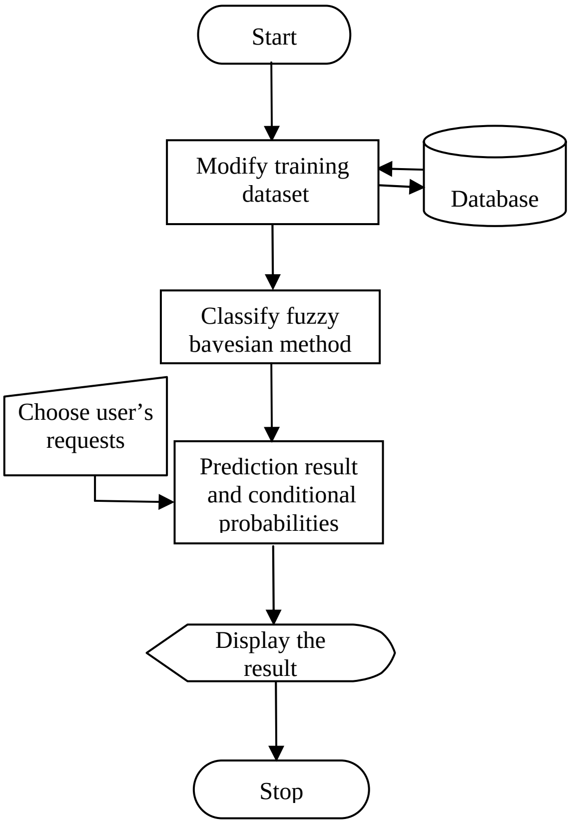

Figure 2. System flow diagram

5. Implementation

Before the Prediction and classification of the system, the user must select the training record sets to use in the prediction and then choose the input variables by clicking on the combo grid boxes. After all, click “Classify” button to calculate coefficient.

In this system, depend on the Jade of 200 datasets calculate for classification of Jade. The system calculates probabilities of 200 datasets that is Presence of probabilities and Absence of probabilities. The user can see the probabilities of Jade classification. The user must choose his requests in this chemical compound list box. And then the user click classify button to calculate the result of Jade classification.

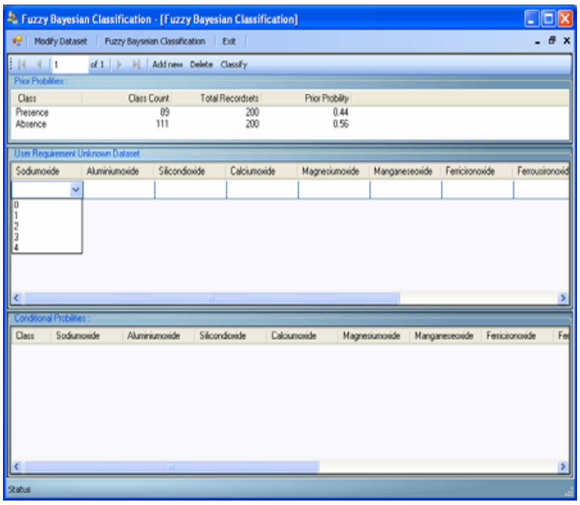

Figure 3. Entry dataset for prediction

After the user click “classify” button, the system predicts upon the user’s requests. If the chemical qualities of jade contain little, it results Absence. If chemical qualities of jade contain large, it results Presence. And then displays containing percentages of each element (Absence or Presence).

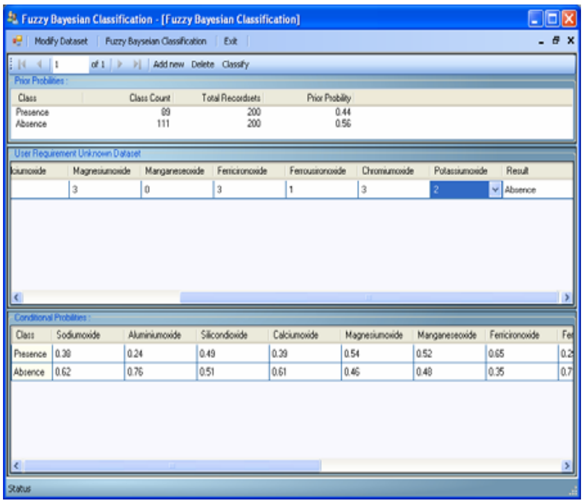

Figure 4. Classifications by fuzzy bayesian method

6. Conclusion

Classification is a form of data analysis that can be used to extract models describing improtant data classes or to predict future data trends. Fuzzy Bayesian classification is based on theorem of posterior probability.

The Fuzzy Bayesian classifier uses the Bayesian formula to calculate the probability of each class given the values of all attributes. This thesis predict the class label of unknown sample given the training data. The relative performance of the fuzzy bayesian classifier can serve as an estimate of the conditional independence of attributes.

This system has presented generating of classification from large datasets. This approach demonstrates efficiency and effectiveness in dealing with jade data for classification.

7. References

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