AN AUTOMATIC EDUCATIONAL QUALITY EVALUATION FUZZY SYSTEM

C. García[1], L.G. Pérez[2], L. Martínez[2] , B. Montes[3] and P.J. Sánchez[2]

[1]Dept. of Computer Science and A.I., University of Granada, 18071 - Granada, Spain
e-mail: gcarlos@fedro.ugr.es
[2]Dept. of Computer Science, University of Jaén, 23071 - Jaén, Spain,
e-mail:martin@ujaen.es, pedroj@ujaen.es
[3]Dept. of Psicology, University of Jaén, 23071 - Jaén, Spain
e-mail:bmontes@ujaen.es

Abstract

The surveys about educational quality in the University are more and more important in nowadays. However, current surveys are not flexible at all, due to the fact that all the questions are assessed in the same domain despite that they are not related to or they have different nature. The aim of this paper is to present an evaluation approach for educational quality that can manage heterogeneous information (numerical, interval valued and linguistic) based on the fuzzy linguistic approach and afterwards will be outlined its Unified Modelling Language (UML) scheme that facilitates its implementation in a JAVA based system. To do so, this approach is based on linguistic decision and evaluation approaches presented in the literature [4,5,8]. The UML scheme will be the basis to develop an object oriented evaluation system implemented in Java. This system will offer a great flexibility to the users (students who answer the pool) because they could provide their responses in different domains according to the nature of the questions used to evaluate the educational quality. In addtion this software system improve the procees of obtaining the final results about the qualification obtained by each lecturer or professor due to it is a automatic system and the pools can be filled, processed and stored in a automatic way.

Keywords

Fuzzy system, heterogeneous information , quality evaluation.

1. INTRODUCTION

The evaluation of the educational quality in the Universities referred to the skills of their lecturers and professors is more and more important nowadays. This evaluation is usually carried out by means of surveys in which the students qualify different aspects related to the educational and research skills of the lecturers and professors. These surveys force the students to express their opinions or preferences in a given numerical scale belong to a specific domain in spite of the different aspects to qualify may have different nature and the knowledge about them is vague and imprecise. The use of fuzzy techniques have provided good results in different evaluation problems [3,10].

In this contribution we present the UML scheme of the JAVA based system developed for the *Office of Quality for the Universities of Andalucía* (South of Spain) that facilitates, improves and automatizes its current evaluation processes. This system is based on linguistic decision and evaluation models presented in [5,6,8] that manage heterogeneous information (numerical, interval valued and linguistic), so it will offer a greater flexibility and better rapport with reality to face this type of evaluation problems than the current ones.

This contribution is structured as follows: in the section 2 we review briefly the decision process that has been used to design the UML scheme for implement the evaluation JAVA system dealing with heterogeneous information, in the section 3 we shall present the UML scheme of the evaluation JAVA system. Eventually some concluding remarks and future work is pointed out.

2. THE EVALUATION SCHEME

On many occasions, evaluation processes have been solved in the literature by means of decision analysis tools [2,3,7] . A common resolution decision process is composed by two phases [13]:

1. *Aggregation phase*: that combines the preferences provided by different sources of information, and

2. *Exploitation one*: it obtains a solution set of alternative/s for the decision problem.

In this contribution we present the UML scheme of a JAVA system that implements an evaluation process based on a decision model that handles heterogeneous information [6,8]. In which the information may be assessed in different domains as numerical, interval valued and linguistic. Therefore, the above scheme is lightly modified according to [6,8]:

1. *Aggregation phase*: To obtain a collective value dealing with heterogeneous information we should carry out the following steps:

    a) *Make uniform the information*. The heterogeneous information is unified into a specific linguistic domain, called Basic Linguistic Term Set (BLTS) and symbolized as S_T. The BLTS is chosen according to the conditions shown in [6].
    Afterwards numerical, interval valued and linguistic input information is transformed into fuzzy sets in S_T, $F(S_T)$, using the transformation functions presented in [6].
    Once all the input information has been expressed by means of fuzzy sets to facilitate the computations with this information we shall transform it into linguistic 2-tuples using the function presented in [8].

    b) *Aggregation process*. Now, the input information is expressed by means of linguistic 2-tuples assessed in the BLTS. In [7] we can find several 2-tuple aggregation operators based on classical aggregation operators to aggregate the linguistic 2-tuples and obtain the collective values we are looking for.

2. *Exploitation phase*: in decision analysis this phase uses the collective preferences obtained in the aggregation phase to look for the best alternative(s) using different choice functions [11,12]. However, in this evaluation problem it will compute an overall value expressed by means of a linguistic 2-tuple [5]. This overall value expresses a measurement of the quality about the skills of the lecturer or professor evaluated.

3. THE UML SCHEME OF THE EVALUATION JAVA SYSTEM

UML is a graphic language to visualize, specify, build and document the elements of a system independently of the software used to its implementation [1,9]. UML provides a standard way to write the schemes for a computer system, we just use the diagram of classes to present the most important elements for the design of an automatic educational quality evaluation system based on the proposal presented in the section 2. The UML scheme in the Fig. 1 shows the classes that allow us to deal with the heterogeneous information in our problem. Now we shall describe the main characteristics of each one of the current classes in this UML scheme:

- **Valuations.** Each question in the quality survey should be assessed by a student. In our problem the valuations can be assessed in different domains of the information but all they share common methods that will be contained in these abstract classes for their later implementation in each one of their subclasses. This class have an important method that will be able to work with heterogeneous information:
    - **unification:** it unifies the different valuations assessed in the different domains of information into a fuzzy set in the BLTS, S_T. This method will have a particular implementation depending on the type of information that is becoming unified (numerical, interval valued or linguistic) [6].

- **Numeric, Interval Linguistic**. These three classes inherit of **Valuations** and represent the three domains of information that we work in our application (heterogeneous information). As these three classes inherit of **Valuations** it allows us to use the property of the polymorphism to be able to decide in execution time what a method it will be executed in each moment (according to the class that belongs the object). Being this an efficient form to work with heterogeneous information.

- **TwoTuple.** This class contains the necessary methods to implements the 2-tuple linguistic representation model presented in [7]. Also this will be the domain of the information where the results are assessed.

- **FuzzySet.** This class is used to represent the domain of information used tu unify the heterogeneous information.

- **Label.** This class is used to represent the syntax of a linguistic label and its semantics given by fuzzy number defined in the [0,1].

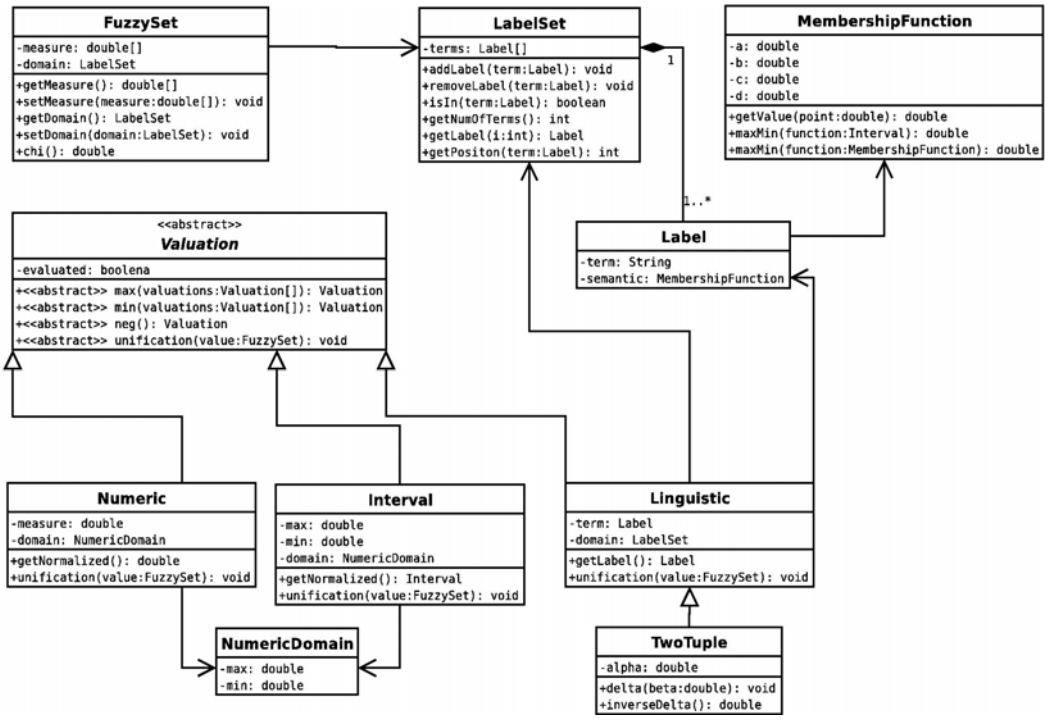

Fig. 1. UML scheme of heterogeneous information

- **LabelSet**. This class is used to represent linguistic term sets that can be used by the students to assess their linguistic assessments related to the factors evaluated linguistically.

- **NumericDomain.** The numeric information as the intervals should be expressed using numbers that belong to range [0,1]. But to offer a greater flexibility to the student to answer the survey we should allow that the numeric information and interval-value can be assessed in any range. A numeric object or interval object have associate an object **NumericDomain** that allow us to indicate the range of permitted values and implement a normalization method into the range [0,1] in the classes **Numeric** and **Interval**.

- **MembershipFunction.** This class represents the parametric representation achieved by a 4-tuple *(a,b,c,d)*, where *b* and *d* indicate the interval in which the membership value is 1, with *a* and *c* indicating the left an right limits of the definition domain of the trapezoidal membership function.

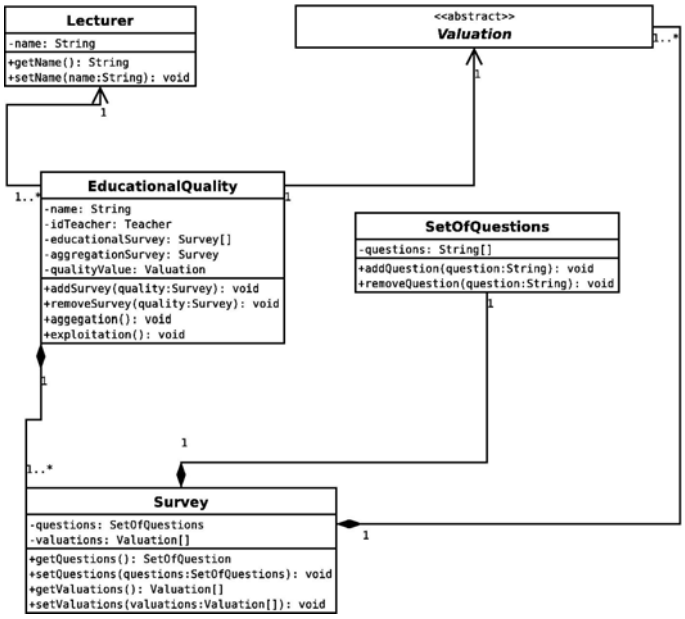

Fig. 2. UML scheme for an automatic educational quality evaluation

We have presented an UML scheme to deal with heterogeneous information now we shall present the UML scheme for an automatic educational quality evaluation system, shown in the Fig. 2. Now we describe the main characteristics of each class of this UML scheme:

- **Lecturer**. The final objective of the survey is to obtain a measure of lecturer's educational skills. Therefore we need to know the lecturer's identity that teaches the subject.

- **SetOfQuestions**. This class allows us to store the questions of the survey. As the questions of all the surveys are the same ones we just need to create an only object of this class for each given object of **EducationalQuality**.

- **Survey.** Each survey belongs to an **EducationalQuality** object shares the same **SetOfQuestions** object that are the questions used to evaluate all the quality surveys. We should have for each survey a utility vector that will represent the answers given by the students to the survey. The utility vector are **Valuation** objects that allow us to represent the heterogeneous information (numerical, interval valued and linguistic).

- **EducationalQuality**: It is the main class of our proposal. We store the name of the subject object of the educational survey, the lecturer's name and the surveys answered by the students for each subject. This is the necessary information to solve our problem of quality evaluation. The main methods to carry out this task are:

    - **aggregation**: In this problem the aggregation method must aggregate educational quality questions with heterogeneous information (numerical, interval valued, linguistic). To do so, we shall use the aggregation process:

        1. *Making the information uniform.* The heterogeneous information is unified using fuzzy sets in the BLTS.
        2. *Aggregating individual educational survey*. For each question of survey, a collective value is obtained by means of an aggregation operator obtaining the *aggregationSurvey.*
        3. *Transforming into 2-tuple*. The *aggregationSurvey* of the survey expressed by means of fuzzy sets are transformed into linguistic 2-tuple in the BLTS.

- **exploitation**: Once it has been completed the aggregation method and we have obtained a collective survey the exploitation method for this problem computes an overall value expressed by means of a linguistic 2-tuple. This overall value expresses a measurement of the lecturer's educational quality, *qualityValue*.

4. CONCLUDING REMARKS AND FUTURE WORK

So far, we have presented the UML scheme to the theoretical background developed in [5, 6, 8] of a JAVA evaluation system that automatizes the surveys done in the Universities about the quality of their lecturers and professors. Due to the fact, we are developing this system as result of research project granted by the Office of Quality for the Universities of Andalucia (Spain). But in the future we want to apply similar methods in the study of quality of textile products.

In addition as we have aforementioned we want to offer different methods for the evaluation process, because depends on the problem it will be necessary to apply different aggregation operators and different methods in the exploitation phase.

5. ACKNOWLEDGEMENTS

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