

Intelligent Student Analysis using Fuzzy Logic

Shubhanjan Chakrabarty, Shubham Zanwar, Namita Ramakrishna
VIT University, Vellore

Abstract:

This paper develops a methodology to analyse various parameters of student data and predict the probability of the student, getting placed in super dream or dream or mass placement company. This is based on fuzzy logic. Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based. Fuzzy logic is a form of many valued logic; it deals with reasoning that is approximate rather than fixed and exact. The applications of fuzzy logic ranges from control theory to artificial intelligence. Fuzzy logic will normalise a data set and give values between 0-1. In intelligent student analysis, we normalise the student data and then analyse the normalised data. Analysis completely depends on the data set. In this case, we are dealing with student data where the data set will include student CGPA, Branch and Attendance. With which, we calculate the possibility of placement of the particular student. Techniques and system model are elaborated in this paper.

Keywords: *Fuzzy logic, Student Profiling, Data Set, Comma separated values, Support Vector Machine, Normalization, Sigmoidal Function*

1.Introduction:

With the advent of fuzzy logic, many fields of computer science and mathematics which had been dormant for a long time, have come to life again. Fuzzy logic has been used in numerous applications such as facial pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid braking systems, transmission systems, control of subway systems and unmanned helicopters, knowledge-based systems for multi objective optimization of power systems, weather forecasting systems, models for new product pricing or project risk assessment, medical diagnosis and treatment plans, and stock trading. Fuzzy logic has been successfully used in numerous fields such as control systems engineering, image processing, power engineering, industrial automation, robotics, consumer electronics, and optimization.

Fuzzy logic is a concept introduced in 1965 by Lofti A Zadeh in his paper "Fuzzy Sets". Fuzzy logic, enhances the concept of Boolean logic meaningfully. Fuzzy logic operates on fuzzy sets. Fuzzy sets are sets whose elements have degrees of membership.

Fuzzy Logic allows you to model in a more intuitive way complex dynamic systems. The major advantages of fuzzy logic include simplicity and interpretability. It provides ease of implementation, ease of modelling, use of fuzzy sets, it also deals with the use of linguistic variables.

Fuzzy logic has a striking resemblance to probability theory. It uses the same range of values from 0 to 1. They are related to one and another. They use the same tools but differ in the usage and very meaning.

The concept of fuzzy logic is adapted in this application of Intelligent student profiling.

2.Literature Review:

Fuzzy logic and its concepts has been the topic of research for a while now.

Intelligent Student Profiling with Fuzzy Models: [1]

“The main objectives of our research are to personalize online educational systems. Based on the educational theory, personalization increases learning motivation, which can increase the learning effectiveness. A Fuzzy epistemic logic has been built to present student's knowledge state, while the course content is modelled by the concept of context. Based on such Fuzzy epistemic logic, the content model, the student model, and the learning plan have been defined formally. A multi-agent based student profiling system has been presented. Our profiling subsystem stores the learning activities and interaction history of each individual student into the student profile database. Such profiling data will be abstracted into a student model. Based on the student model and the content model, dynamic learning plans for individual students will be made. Students will get personalized learning materials, personalized quiz, and personalized advices. In order to understand the students' perception of our prototype system and to evaluate the students learning effectiveness, a field survey has been conducted. The results from the survey indicate that our prototype system makes great improvement on personalization of learning and achieves the effectiveness of learning “

Proposal of Fuzzy Logic-based Students' Learning Assessment Model Constanza Huapaya:[11]

One of the main advantages of this model is that it allows for a representation of interpretable knowledge since it is based on rules when the reasoning is well defined as well as when the reasoning is intuitive, as a result of experience. For instance, in the specific developed model it has been concluded that four out of the 27 rules can be discarded following the experienced teachers' opinion. As a future line of research new evidence will be added to the diagnosis model, such as the date of the tests, level of difficulty of the topics.

Fuzzy Logic in Student Modeling[6]

An effective adaptive tutoring system has to be responsible for tracking cognitive state transitions of learners with respect to their progress or non-progress. The alterations on the state of student's knowledge level are not linear. They deal with uncertainty. Thus, a solution to represent these is fuzzy logic. Therefore, the target of this research was to develop a rule-based fuzzy logic system, which models the cognitive state transitions of learners, such as forgetting, learning 2.4 A Novel Rule-Based Fuzzy Logic System ... 60 2 Fuzzy Logic in Student Modelling or assimilating. The presented rule-based fuzzy logic system identifies and updates each time the student's knowledge level not only for the current concept, which is delivered to the learner, but also for all the related concepts with this concept. To achieve that, the system considers either the learner's performance or the knowledge dependencies that exist between the domain concepts of the learning material. In the particular rule-based fuzzy logic system, fuzzy sets are used in order to describe how well each individual domain concept is known and learned. Furthermore, it uses a mechanism of rules over the fuzzy sets, which is triggered after any change of the value of the knowledge level of a domain concept and updates the values of the knowledge level of all the related domain concepts with that. Therefore, the educational system, which has integrated the particular rule-based fuzzy logic system, is able to makes dynamic decisions on how the teaching syllabus is presented to the learner to fit his/her personal needs and learning pace. The operation of the system is based on the knowledge domain representation that is implemented through a Fuzzy Related-Cognitive Network. This kind of knowledge domain representation helps to manage to represent either the order in which the domain concepts of the learning material have to be taught and organized, or the knowledge dependencies that exist between the domain concepts. This is significant because the knowledge level of a domain concept increases or decreases due to changes on the knowledge level of a related domain concept. The design of the learning material and the definition of the individual domain concepts that it includes, are based on the knowledge and experience of domain experts.

3.Intelligent Student Profiling

This paper discusses the use of fuzzy logic in analysing student data with respect to different parameters such as

- CGPA
- Attendance
- Field of study

These parameters are analysed, to predict where the student will get placed. There are several Student profiling systems using fuzzy logic which analyse different behaviours. This application of Student Profiling takes into consideration, different parameters of data and produces the desired output.

The application is coded using MATLAB.

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python. MATLAB has a toolbox, called Fuzzy Logic Toolbox which helps in designing fuzzy logic based applications. Fuzzy Logic Toolbox provides functions, apps, and a Simulink block for analysing, designing, and simulating systems based on fuzzy logic. The product guides you through the steps of designing fuzzy inference systems. Functions are provided for many common methods, including fuzzy clustering and adaptive neuro fuzzy learning.

The important concepts used in the development of this application are:

- Data Sets
- Normalization
- Comma Separated values
- Sigmoidal Functions
- Support Vector Machine
- De-normalization

4.System Model

The architecture of a Fuzzy Inference Engine:

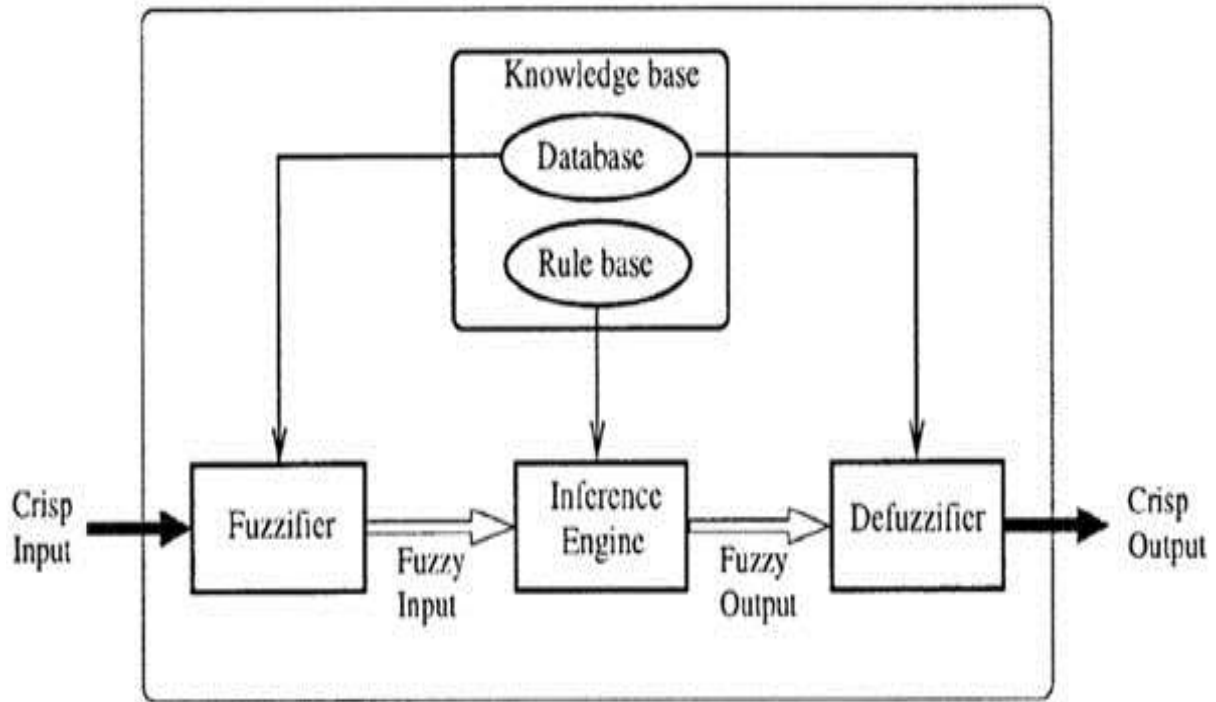


Figure 1: System Model

The model comprises of

1. Fuzzifier: Converts the crisp input to a linguistic variable using the membership functions stored in the fuzzy knowledge base.
2. Inference Engine: Using If-Then type fuzzy rules converts the fuzzy input to the fuzzy output.
3. Knowledge Base: The rule base and the database are jointly referred to as the knowledge base.
 - A rule base containing a number of fuzzy IF–THEN rules;
 - A database which defines the membership functions of the fuzzy sets used in the fuzzy rules.
4. De-fuzzifier: Aggregate the qualified consequents to produce a crisp output.
5. Sigmoid Function: A sigmoid function is a mathematical function having an "S" shaped curve (sigmoid curve). Sigmoid function refers to the special case of the logistic function.

6. Algorithm

The algorithm progresses as follows:

- Start
- Get all the data of the data set.
- Store all the data in a CSV (comma separated values) form.
- Use sigmoidal function to normalise the data set.
- Use SVM (Support Vector Machine) classification algorithm or Softmax.
- De-normalise it after that, to display the complete data with the analysed result.

- Display the analysed result.

6. Pseudocode

The pseudo code is discussed below:

```

begin loop
    t:=0
    Initialise data P(t);
    while not done do
    {
        Evaluate P(t);
        P'(t)=Select[P(t)];
        P''(t)=Apply Sigmoidal function;
        P(t+1)=Introduce[p'(t)+P(t)];
        t:=t+1;
        a[t] = Use SVM ;
        Display the analysed result;
    }

```

6. Code Snippet

% Function to fuzzify the sets

```
function y = fuzzify(x)
```

```
    % x is the data which you want to fuzzify, P is parameter for trapeziod function P = [a, b, c,
    d]
```

```
    P = [1 2 3 4];
```

```
    % using Trapezoidal-shaped membership function for fuzzification
```

```
    y = trapmf(x,P);
```

% For De-fuzzification

```
function out=defuzzify(mf)
```

```
x=rand(size(mf));
```

```
size(x)
```

```
out=defuzz(x,mf,'centroid');
```

7.Results

As we can see from the below example, passing a data set with inputs such as CGPA and attendance and using the trapezoidal MATLAB function to normalize the data set generates the results.

```

0      0      0
1      1      0

```

```
>> y= fuzzyfy([2 3 1])
```

```
y=
```

```

1      1      0

```

```
>> out=defuzzify(y)
```

```
out= 0.7729
```

Figure 2: Results

The above figure shows that after fuzzification by using trapezoidal function we get the normalized form. So here '0' denotes that the student will not be placed because it has less attendance or low CGPA. Similarly, '1' denotes that the student will get placed.

8.Conclusion

The following conclusions were drawn:

Fuzzy logic helps us analyze student data easily due to its multiple-valued nature. In this paper, we have analyzed student data on various parameters and the probability of him/her getting placed is obtained. Fuzzification and De-fuzzification methods were used. This application can further be extended to analyze student data based on various parameters to analyze the probability of getting placed in a particular company, by feeding in data about the requirements for the particular company. Intelligent student profiling can also be extended for analyzing student data for e-learning activities, predicting marks, student modeling.

9.References

1. Xu, Dongming, Huaiqing Wang, and Kaile Su. "Intelligent student profiling with fuzzy models." System Sciences, 2002. HICSS. Proceedings of the 35th Annual Hawaii International Conference on. IEEE, 2002.
2. Voskoglou, Michael Gr. "A fuzzy model for analogical problem solving." arXiv preprint arXiv:1204.6415 (2012).

3. Tsaganou, Grammatiki, Maria Grigoriadou, and Theodora Cavoura. "Modelling Student's Comprehension of Historical Text Using Fuzzy Case-Based Reasoning." ECCBR Workshops. 2002.
4. Almohammadi, Khalid, and Hani Hagra. "An adaptive fuzzy logic based system for improved knowledge delivery within intelligent E-Learning platforms." Fuzzy Systems (FUZZ), 2013 IEEE International Conference on. IEEE, 2013.
5. Shen, RuiMin, Yiyang Tang, and TongZhen Zhang. "The intelligent assessment system in Web-based distance learning education." Frontiers in Education Conference, 2001. 31st Annual. Vol. 1. IEEE, 2001.
6. Chrysafiadi, Konstantina, and Maria Virvou. "Student modeling approaches: A literature review for the last decade." Expert Systems with Applications 40.11 (2013): 4715-4729.
7. Ferreira-Satler, Mateus, et al. "Fuzzy ontologies-based user profiles applied to enhance e-learning activities." Soft Computing 16.7 (2012): 1129-1141.
8. Fazlollahtabar, Hamed, and Iraj Mahdavi. "User/tutor optimal learning path in e-learning using comprehensive neuro-fuzzy approach." Educational Research Review 4.2 (2009): 142-155.
9. Voskoglou, Michael Gr. "A study on fuzzy systems." arXiv preprint arXiv:1212.2614 (2012).
10. Gisolfi, Antonio, Antonina Dattolo, and Walter Balzano. "A fuzzy approach to student modeling." Computers & Education 19.4 (1992): 329-334.
11. Huapaya, Constanza Raquel. "Proposal of fuzzy logic-based students' learning assessment model." XVIII Congreso Argentino de Ciencias de la Computación. 2012.