Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 24 - 33
Received 25 April 2021; Accepted 08 May 2021.

Employing Algorithms for Testing the Level of Intelligence Students Have for Admission in Gifted Schools

Marwa Malik Hameed,

Iraqi Ministry of Education

Prof. Dr. Dahir Abbas Reda,

Department of Information Technology, Technical College of Management

Abstract

Gifted students have private schools in Iraq, which are 7 schools distributed in (Baghdad, Mosul, Basra, Anbar, Najaf, Maysan, DhiQar) and it is considered one of the important mixed educational institutions as each school accepts less than 20 students each year, through special tests it is suggested A model for measuring the degree of creativity and talent of students applying for admission to Iraqi gifted schools, and by using one of Fuzzy Logic's artificial intelligence techniques and the SVM algorithm, an expert system was built that contains an inference base that included three test materials: (intelligence, mathematics, science) to determine the ability to make decisions based on Specific standards and ratios for each subject of the test, and the results of the students 'tests for gifted schools were evaluated based on fuzzy logic to explore the logical results of a model based on IF - THEN rules, as well as the (SVM) algorithm that showed high strength and reliability for the proposed model.

Keywords: Fuzzy Logic, SVM, Python, visual studio, Schools for the gifted

1. Introduction

Today, the world is witnessing great developments and advancements in information and communication technology, and this progress is driving change in all areas of life, especially in the field of education, as advanced devices and modern technology have a great and effective impact on education and in a positive way, and that the progress of science leads to its progress. And increase its efficiency, Modern trends in education have become necessary in what is happening in terms of changes, imposed by social, technological, and economic factors, and the nature of the cultural environments of modern societies, following the requirements of the times, In 2019 researcher E G Sesari presented the application of the linear match method to computer-based EPPS psychological tests [11], Researcher G N Putri presented in 2020 a model for global intelligence tests by adopting psychology measures using the Fuzzy Model algorithm and concluded that the computer intelligence test is better than the paper IQ test [12]. This paper discusses Proposing a system for measuring the talent and creativity of students applying for the Iraqi Gifted Schools due to the absence of an electronic method for measuring this, as they rely on traditional methods that take a long time and several stages and many days for the exams. This method has been proposed and developed according to the approved curricula of the schools mentioned above in the tests.

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2. Fuzzy Logic

In (1965) the scientist LotfiZadeh, a computer scientist, electrical engineer, and artificial intelligence researcher, proposed the Fuzzy set because he saw an urgent need to simplify complex systems, and a better way to process data, and the concept of Fuzzy Logic came from the idea of the degree of belonging, which She became the backbone of Fuzzy Set Theory. As the fuzzy logic is a logic that is very similar to how a person performs, and the fuzzy logic is based on the presence of a function whose value is at a certain element is a real value located between [1,0] This value expresses the belonging of this element to a group, if the value of this function One, then the element completely belongs to it, and if its value is zero, then the element never belongs to this group. Either if its value is between [1,0], it indicates the extent of the element's belonging to this group.
Fuzzy logic is based on the theory of fuzzy groups, and it is a generalization of the classical group theory, meaning that this theory (Classical set) is a special case of fuzzy sets, as shown in Figure (1), and degrees of affiliation is measured as real numbers between zero and one.[1] [2], [5]

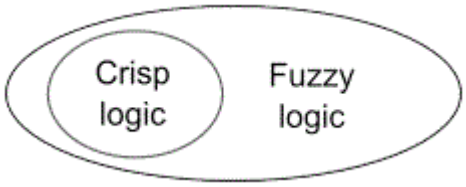

Figure 1: The classical set theory is a subset of the theory of fuzzy sets [2]

Membership Functions2.1

There are several types of membership functions whose simplest organic functions are formed using straight lines due to their simple formulas and computational efficiency . Both Triangular and trapezoidal belonging functions have been used on a large scale, especially in real-time applications, because the belonging functions consist of line segments Straight, it is not smooth at the corner points specified by the parameters. The most common types of MF are**- :**

Triangular MFs , Generalized bell MFs ، Trapezoidal MFs ، Gaussian MFs ،

,S- Shaped Membership Function ,[7]

2.2 Fuzzy logic mechanism

Fuzzy logic depends on the introduction of real values and manipulating them fuzzy to obtain real output values used in control and decision-making processes in a manner that gives greater accuracy to the factors, given the representation of a wide range of probability when fuzzing. The fuzzy conclusion mechanism is according to the following steps:

1. Fuzzification
2. K nowledge base

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3. decision making
4. defuzzification[10]

3 . Support Vector Machines

Linear and nonlinear classification tool, it comes within the category of supervised learning algorithm used in classification, regression, and detection of outliers, but most often the supporting vector machine (SVM) is used in classification, the (SVM) algorithm is based on the idea of finding the best superplane based By dividing the dataset into two types in the best way possible, and the classification is done by finding the hyperplane and defining it that distinguishes between two categories, and it is evident that the further away from the points from the hyperplane, the greater the confidence that the points have been correctly classified, so the points must be farther away.On the hyperplane as much as possible, bearing in mind that it remains on the correct side of the dividing line, and therefore when we add new data to test it will be classified according to the side in which it is located about the hyperplane, and the two closest points to the hyperplane are the supporting vectors (Support Vector), And the supporting vectors are the data points closest to the hyperplane, and if these points are removed from the dataset, the location of the hyperplane that divides the data will change.So these points can be counted as the important elements in the data set. As shown in figure (2) below: [4], [8].

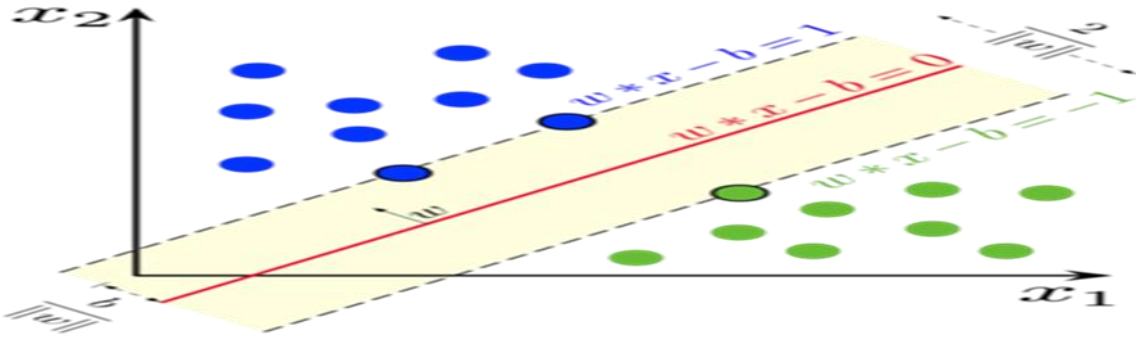

Figure 2 illustrates the hyperplane that separates the data in an algorithm SVM [8]

And that the best way to divide the data set into two classes, is to choose a hyperplane with the largest margin between it and any point in the training data set, as the margin is the distance between the hyperplane, and the closest point of any of the data sets, the goal is Choosing a hyperplane with the largest margin between it and any point in the training data set to increase the likelihood that any new data will be classified correctly. Figure (3) illustrates the margin [9].

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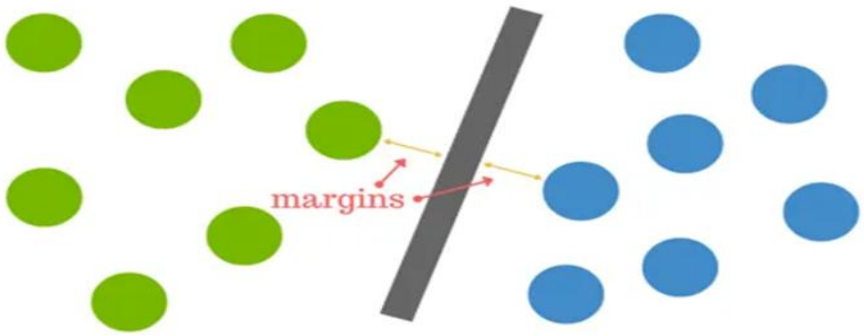

Figure 3 shows the margin, which is the distance between the hyperplane and its closest points in the (SVM) [9]

3.1SVMKernel

The kernel can be used to transform the data into a higher-dimensional space referred to as the kernel space, where the data can be separated linearly. In the nucleus space, thus obtaining a super-linear plane to separate the different classes involved in the classification task instead of resolving the super-layer separating the surface in the input space. This is an attractive method since the load on core space is insignificant compared to learning the nonlinear surface.

There are some common functions, including: [6]

- Polynomial function :$k(x,u) = (ax^T u + c)^2 \ldots\ldots$ (1)
- Gaussian radial basis function (RBF):$k(x,u) = \exp\left(-\frac{\|x-u\|^2}{\sigma^2}\right)$ ..(2)

4. Data

The results of the data were based on tests for gifted schools in Iraq for three subjects: (Intelligence - Mathematics - Science) with an average of 25 questions, 50% of the questions are for Intelligence, 30% Mathematics and 20% Science, using Python to write the proposed algorithm code through the (VS) platform. Visual studio.

5. The proposed system for evaluating test results

5.1 The proposed system using fuzzy logic to evaluate test results

The proposed system relies on the ambiguous identifier for decision-making and the processes included in the system based on fuzzification, i.e. the process of assigning numerical values in a fuzzy group as the inputs must be real values that are converted into ambiguous inputs in the form of linguistic values based on membership functions (functions of affiliation) The trapezoidal MF, the Triangular MF and the input parameter were also used for the tests, and the numerical values were divided into three levels for the organic functions and for each of the three subjects, the first level describes the range of linguistic values represented by the low (Less) and the second

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level is the range of medium linguistic values (Medium) and the third level represents With the range of high linguistic values (High), and the numeric inputs were converted into linguistic variables by giving verbal expressions to them while determining the digital domain for each expression independently

Figure (4) shows the input parameter for representing the intelligence subject curve and the functions used according to levels.

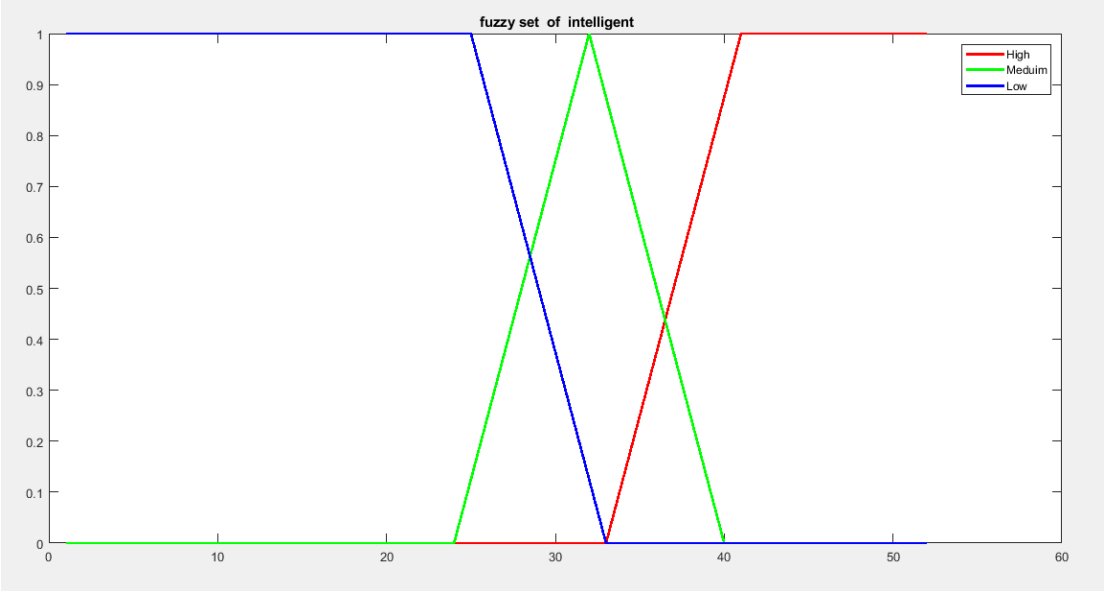

Figure (4) represents the test curve for the subject intelligence

Based on figure 4 above, the fuzzy set equation from intelligence test can be shown in the equation below.

$$\mu\text{less (Intelligence)} = \begin{cases} 1 & x \leq 24 \\ \frac{32-x}{32-24} & 24 < x < 32 \\ 0 & x \geq 32 \end{cases} \quad \ldots\ldots\ldots (3)$$

$$\mu\text{medium (Intelligence)} = \begin{cases} 0 & x \leq 24 \\ \frac{X-24}{32-24} & 24 < x < 32 \\ \frac{40-X}{40-32} & 32 \leq X \leq 40 \\ 0 & x > 40 \end{cases} \quad \ldots (4)$$

$$\mu\text{high (Intelligence)} = \begin{cases} 1 & x > 40 \\ \frac{X-32}{40-32} & 32 \leq x \leq 40 \\ 0 & x < 32 \end{cases} \quad \ldots\ldots (5)$$

As for Figure (5), the input parameter is shown to represent the mathematics curve for the test and the membership function used.

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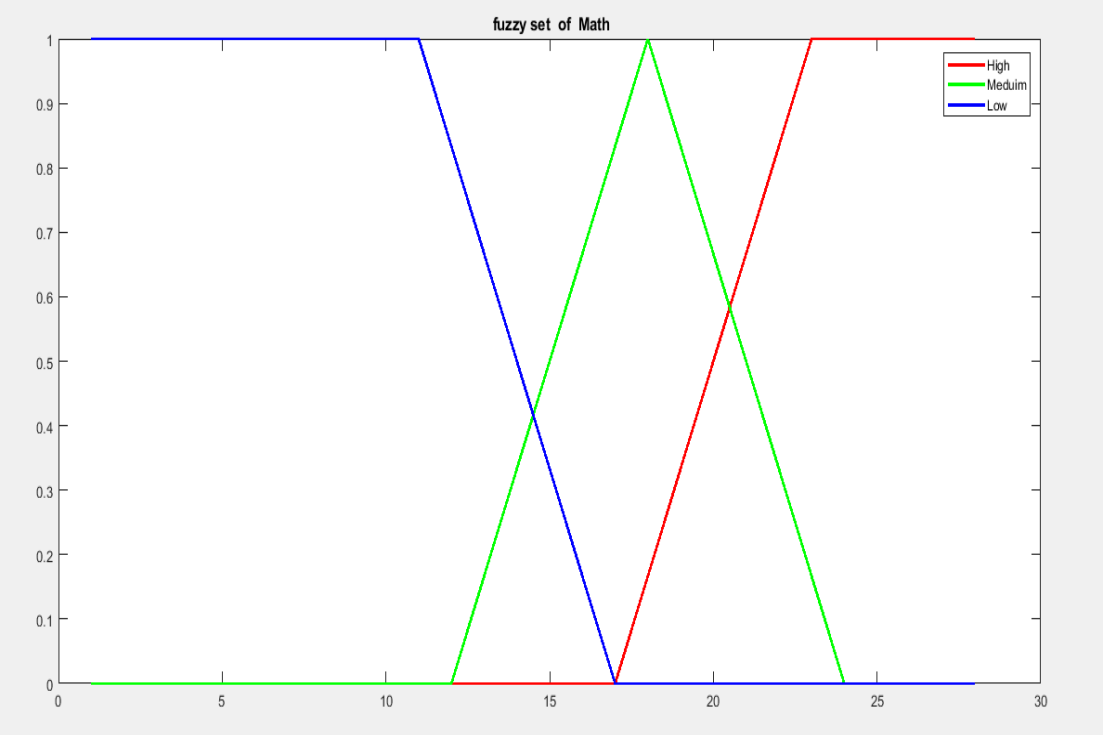

Figure (5) represents the test curve for mathematics

Based on figure 5 above, the fuzzy set equation from mathematics test can be shown in the equation below.

$$\mu\text{less (math)} = \begin{cases} 1 & x \leq 12 \\ \frac{18-x}{18-12} & 12 \leq x \leq 18 \\ 0 & x \geq 18 \end{cases} \quad \text{.....(6)}$$

$$\mu\text{medium (math)} = \begin{cases} 0 & x \leq 12 \\ \frac{X-12}{18-12} & 12 < x \leq 18 \\ \frac{24-X}{24-18} & 18 < X < 24 \\ 0 & x \geq 24 \end{cases} \quad \text{.....(7)}$$

$$\mu\text{High (math)} = \begin{cases} 1 & x > 24 \\ \frac{X-18}{24-18} & 18 < x < 24 \\ 0 & x < 18 \end{cases} \quad \text{.....(8)}$$

Also, Figure (6) shows the input parameter to represent the curve of the science subject for the test and the membership function used

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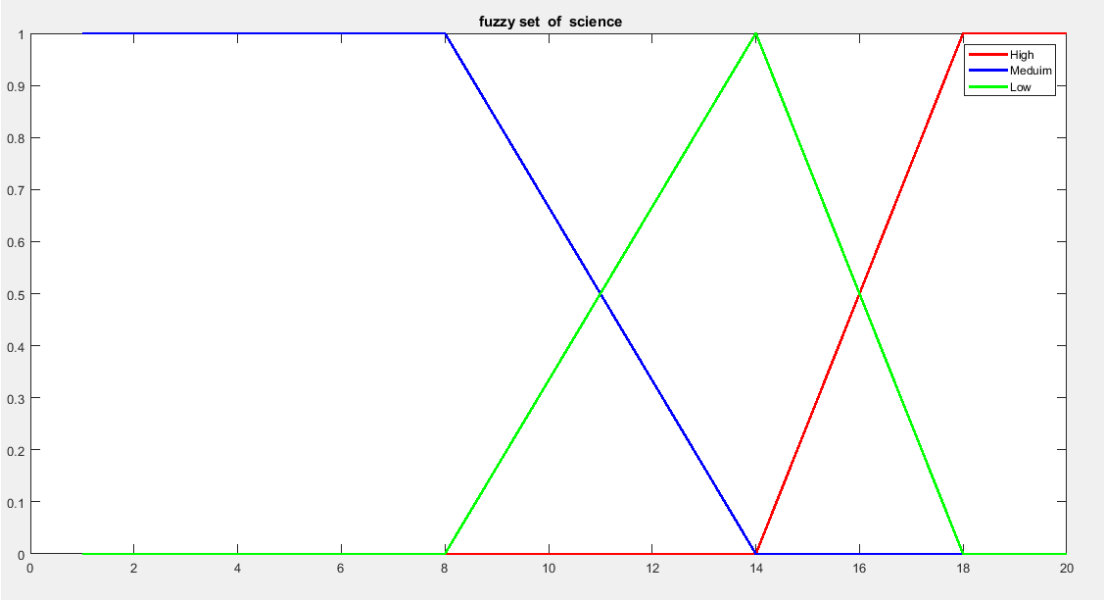

Figure (6) represents the test curve for the science subject

Based on figure 6 above, the fuzzy set equation from Science test can be shown in the equation below.

$$\mu\text{less (Sciences)} = \begin{cases} 1 & x \leq 8 \\ \frac{14-x}{14-8} & 8 < x < 14 \\ 0 & x \geq 14 \end{cases} \quad \ldots\ldots(9)$$

$$\mu\text{medium (Sciences)} = \begin{cases} 0 & x \leq 8 \\ \frac{X-8}{14-8} & 8 < x < 14 \\ \frac{18-X}{18-14} & 14 < X < 18 \\ 0 & x \geq 18 \end{cases} \quad \ldots\ldots(10)$$

$$\mu\text{high (Sciences)} = \begin{cases} 1 & x > 18 \\ \frac{X-14}{18-14} & 14 < x < 18 \\ 0 & x < 14 \end{cases} \quad \ldots\ldots(11)$$

And finally, Table (1) following shows the rules of inference (Rule Evaluation) that were used in the research model, which was formulated in the form of rules from IF_Then.

Table (1) IF - THEN inference rules used in the study

Rule	Condition	Effect
Rule-1	If Intelligence value is Less AND math value is Less AND Sciences value is Less	THEN Dimension level is low
Rule-2	If Intelligence value is Less AND math value is Less AND Sciences value is medium	THEN Dimension level is low
	⋮	
Rule-27	If Intelligence value high AND math value is	THEN Dimension

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	high AND Sciences value is high	level is Excellent

5.2 The proposed system using SVM algorithm to evaluate test results

The model was built for the multiple supporting vector machine (MSVM) algorithm for selecting students according to the test results in the exam for the three subjects through an Excel file that contains the scores of 769 students as a result of the electronic tests for three subjects (intelligence, science, mathematics). Cross-Validation 80% of the data for training and 20% for the test, and the algorithm has been trained to become ready to distinguish the input grades, to obtain the ideal weights that represent elementary and constant weights in the test stage network so that the network can analyze the input, and calculate the accuracy of the results achieved for selecting students, use the method Polynomial kernel and kernel RBF as the Polynomial kernel method achieved accuracy (98%) while the kernel RBF method achieved accuracy (88%) and the algorithm (1) demonstrates the operation of the MSVM algorithm.

Algorithm (1) MSVM
Input: students' grades Outputs: assessment of students' levels
Start Step 1:upload training data Step 2:Cross-Validation 80% of the data for training and 20% for the test . Step3 :Assume a random distribution within the range weights (-0,5, 0,5). Step 4: Determine Learning rate L = 0.2 . Step 5 :Using the SVM algorithm A: Train the model using the polynomial method, and impose the coefficients c1 = 1 and degree = 3 on the basis of relationship (1). B:Train the model using the RBF method and force the coefficients C1 = 0.1, Gama = 0.5 based on relationship (2). Step 6:the model test and accuracy calculation, whereby RBF method 88% accuracy and by polynomial method 98% accuracy 98% . End

6. Results

The results tests showed, as shown in Table (6), and through the application of the Fuzzy logic algorithm and the multiple supporting vector machine algorithm (MSVM) by applying two methods of Polynomial kernel and kernel RBF, it is also noted that the accuracy of Fuzzy algorithm reached 87%, and the accuracy of the Polynomial method also reached To 98% while it was 88% for the RBF method. This means the reliability and reliability of the proposed models for testing and selection.

The algorithm applied	The name of the database	Training sample size	Test sample size	The accuracy of the

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					algorithm
MSVM	Polynomial	EXAM	616	153	98%
MSVM	RBF	EXAM	616	153	%88
The accuracy of the algorithm fuzzy					
FUZZY logic		%87			

Table (6) shows the accuracy of the results from the application of the Fuzzy Logic and SVM algorithms

7. Conclusions

- Table (6) showed the superiority of the SVM application over the Fuzzy method
- The accuracy of the Polynomial method is 98% while the RBF is 88%.
- The results in tables (6) show the accuracy and reliability of the methods used for testing and evaluation.
- Emphasis on the use of smart algorithms and methods in testing and evaluating students for admission to gifted schools
- The fuzzy logic model relies on a strong inferential system in which all studied cases are discussed for three types of tests.
- Computer applications such as Python have enabled us to use modern information technologies to address complex problems in real life .

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