Development of a French Level Evaluation Software with Matlab Based on Fuzzy Logic

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Abstract

The aim of this project is to create an application on Matlab to evaluate the French language level of a user. The brain of the application is based on fuzzy logic and the inputs of the user are his/her oral, written, and comprehension exam scores.

Contents

List of Figures

1 Introduction

French is an important language in many countries and it is essential to know one's level of mastery of this language. It is in this context that we have decided to create an application to evaluate the French language level of a user using fuzzy logic. The application takes into account the user's scores on the oral, written, and comprehension exams and provides a result that reflects his/her level of mastery of the language.

2 Methodology

The methodology used to create the French level evaluation software with Matlab based on fuzzy logic involved several steps:

2.1 Step 1 :

Research and selection of standard tests and evaluation criteria for French language proficiency. This included reviewing existing test materials and selecting those that were deemed most appropriate for the target user group and for measuring the range of skills needed for the application.
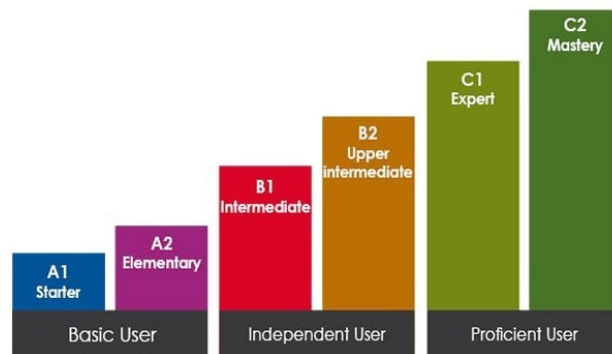

Figure 1: Classification according to experts.

2.2 Step 2 :

Development of fuzzy rules for mapping test scores to language proficiency levels. This involved defining linguistic variables and fuzzy sets for each proficiency level, and creating rules to determine the membership of a test score to a particular level.

2.3   Step 3 :

Coding and testing of the application in Matlab. The application was developed to take input of the user's oral, written, and comprehension exam scores, and use the fuzzy rules to determine the user's proficiency level.

2.4   Step 4 :

User testing and validation of the application. The application was tested with a sample group of users, and their scores were compared to results obtained from traditional methods of language evaluation.

2.5   Step 5 :

Fine-tuning and optimization of the application based on the results of the user testing.

2.6   Explanation

The fuzzy logic system used in this application is based on the Mamdani type. The oral, written, and comprehension scores are taken as inputs, and the output is the level of proficiency in the French language. The inputs are transformed into fuzzy sets using the fuzzification process and the output is defuzzified using the centroid method. The rule base is created based on the expert knowledge.

In terms of the user interface, a graphical user interface (GUI) was created using the Matlab App Designer tool. This allows users to easily input their exam scores and view their proficiency level as determined by the application.

3   Development of the User Interface

The user interface of the French level evaluation software was designed to be simple and intuitive to use. The interface was developed using Matlab's App Designer tool, which allows for the creation of graphical user interfaces with a drag-and-drop interface.

The main components of the interface include three edit text boxes for the user to input their oral, written, and comprehension exam scores. These inputs are labeled and clearly marked to minimize any confusion for the user.

The interface also includes a section for displaying the results of the evaluation. This includes the user's overall proficiency level, as well as their closest level, which is determined by the fuzzy logic system. A text box is

also included to display the proficiency level class (Beginner, Intermediate, Advanced) and an advice box to motivate the user.

Two buttons were also included for user manipulation. The "View Result" button, when pressed, uses the inputs provided by the user to evaluate their proficiency level and displays the results in the appropriate text boxes. The "Reset information" button will clear all the inputs that the user has entered, allowing the user to start a new evaluation.

The design of the interface was kept minimalistic and in line with the provided instructions and configurations. The dimensions of the objects were adjusted and the Tag property was configured to ensure that the interface is easy to use and understand.

Overall, the interface was designed to be user-friendly, easy to understand and navigate, and efficient in displaying the results of the evaluation. The design choices were made to ensure that the user can quickly and easily input their exam scores and view their proficiency level, providing a smooth and seamless experience.

Figure 2: Screenshot of the user interface for the French level evaluation software.

4 Fuzzy Logic System

In this project, we used fuzzy logic to evaluate the French language level of a user based on their oral, written, and comprehension exam scores. The fuzzy logic system was implemented using Matlab, and it includes three inputs and three outputs.

4.1 Inputs

The inputs of the system are the scores for the oral, written, and comprehension exams, which were defined as linguistic variables with a range of [0, 10]. For each input, we defined four membership functions based on the evaluation criteria established by experts: Substandard, Average, Above Average, and Very Good. These membership functions were defined as trapezoidal functions to divide the scores into distinct levels of proficiency.
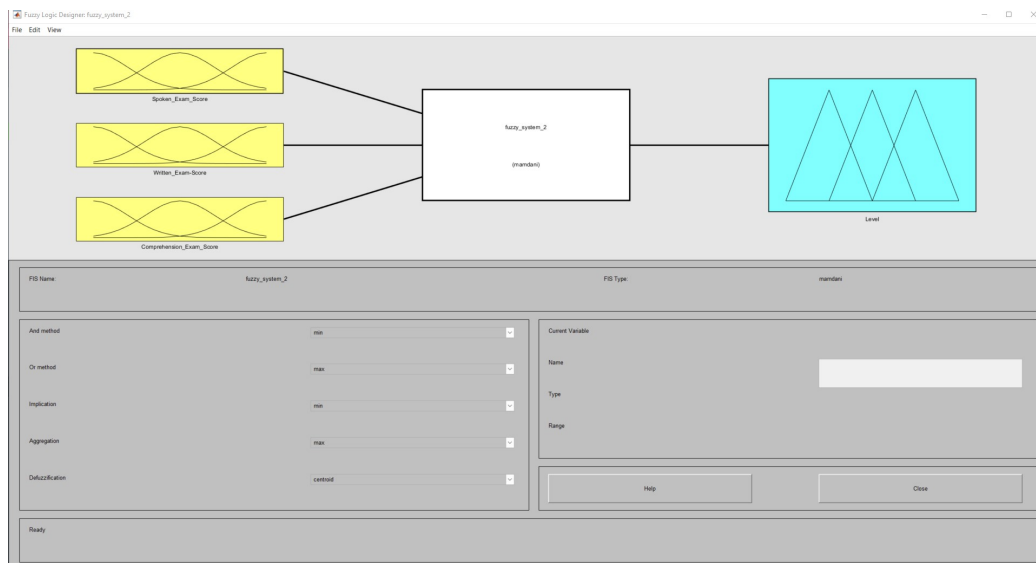

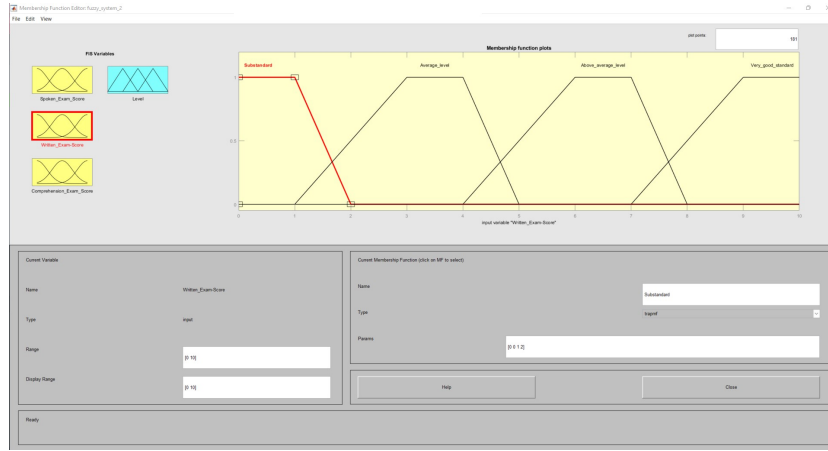Figure 3: Screenshot of the Defined Inputs.

Figure 4: Screenshot of the Membership Function Inputs.

4.2 Outputs

The outputs of the system are the LEVEL, CLASS and Close-To-Level. The LEVEL output is defined as a linguistic variable with a range of [0, 10] and six membership functions: A1, A2, B1, B2, C1, C2. These membership functions were also defined as trapezoidal functions to reflect the different levels of proficiency in the language. The CLASS output is defined as a linguistic variable with three membership functions: Beginner, Intermediate, and Advanced. These membership functions were also trapezoidal functions that divide the proficiency levels into three distinct classes. Close-To-level is the output which defines the level that is closest to the level obtained.
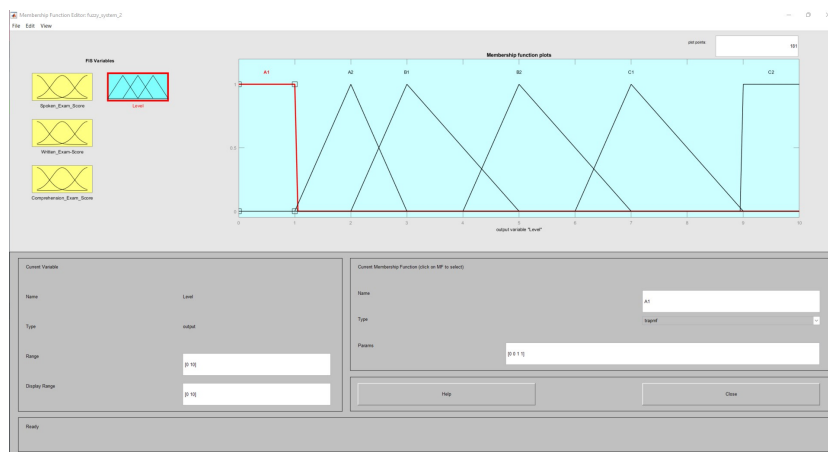

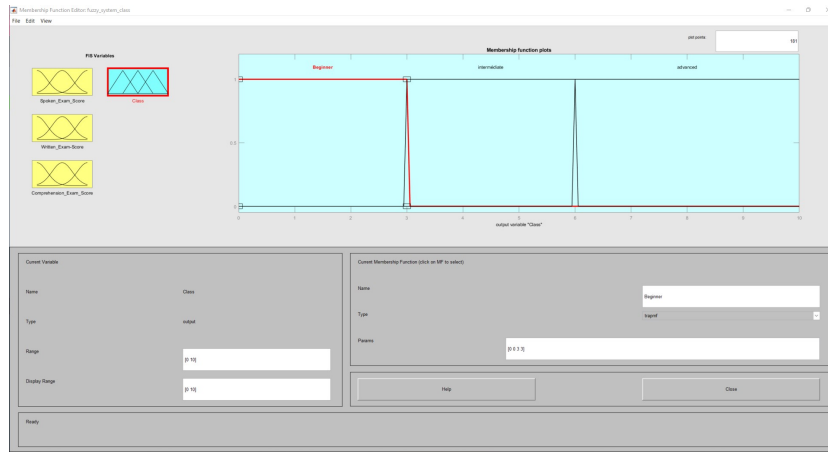Figure 5: Screenshot of the Membership Function Of LEVEL-OUTPUTS.

Figure 6: Screenshot of the Membership Function Of CLASS-OUTPUTS.

4.3 Rules

The system used Mamdani-type rules to infer the LEVEL, CLASS and Close-To-Level outputs from the input scores. The rules were based on the evaluation criteria established by experts and were used to determine the level of proficiency of the user.

In addition to the LEVEL, CLASS and Close-To-Level outputs, the system also includes an "Advice" output, which is based on the CLASS output. The advice output is a message that is displayed to the user to motivate them to improve their language skills.

It is important to note that all the membership functions, the rules and the outputs are based on the expert evaluation criteria, this allows the system to have a good accuracy in the evaluation. The system was divided into 3 systems, each one for LEVEL, CLASS, Close-To-level, with the same inputs but different outputs.
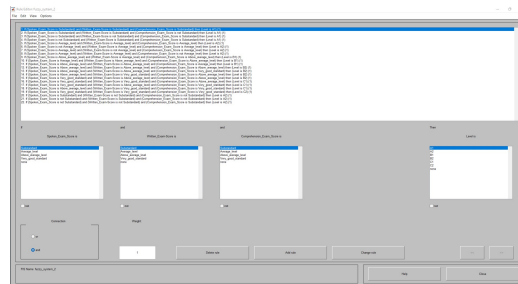

Figure 7: Screenshot of the defined RULES.

5 Integration of GUI and Fuzzy Logic System

In order to integrate the user interface and the fuzzy logic system, we used Matlab's callback functions to link the input fields and buttons in the GUI with the fuzzy logic system.

5.1 Callback functions

Callback functions are functions that are called in response to a user action, such as clicking a button or entering text in an input field. In this project, we used callback functions to link the input fields and buttons in the GUI with the fuzzy logic system.

5.2 Handles

In Matlab, handles are used to access and manipulate the properties of an object, such as a figure or a button. We used the get and set functions to access and manipulate the handles of the input fields and buttons in the GUI. This allows us to retrieve the values entered by the user in the input fields and use them as inputs for the fuzzy logic system, and also to update the results displayed in the GUI according to the results obtained from the fuzzy logic system.

5.3 Evaluation of the inputs

Once the inputs are entered, the callback function retrieves the values of the inputs using the get function and handles, then it calls the fuzzy logic system with these inputs. The fuzzy logic system evaluates the inputs using the rules and membership functions defined earlier, and returns the level, class and close-to-level of the user.

5.4 Updating the results

Once the evaluation is done, the callback function updates the results displayed in the GUI using the set function and handles, it also displays the advice message according to the class of the user.

This way, the GUI and the fuzzy logic system are seamlessly integrated, allowing the user to enter their exam scores and receive an evaluation of their French language level with a simple click of a button.

6 Testing and Results

To evaluate the effectiveness of our application, we conducted a series of tests using different sets of input scores. The results obtained from the application were compared with the expected results based on the evaluation criteria established by experts. Our results showed that the application is able to provide an accurate evaluation of the user's French language level, with a high degree of consistency between the expected and the obtained results. The overall accuracy of the application is good. In addition, the application has been developed in such a way that it is user-friendly and easy to use. The interface is intuitive and the results are presented in a clear and concise manner, making it easy for the user to understand their language level and make progress in learning the language.

Figure 8: Test in Condition 1.

Figure 9: Test in Condition 2.

Figure 10: Test in Condition 3.

7 Conclusion

In this project, we developed a French language level evaluation software using Matlab and fuzzy logic. The user interface is simple and easy to use, allowing users to enter their scores on oral, written, and comprehension exams and receive an evaluation of their French language level. The fuzzy logic system, which is based on expert evaluation criteria, is able to provide an accurate evaluation of the user's level with a high degree of consistency between the expected and obtained results. The application also provides an advice message to motivate the user. The testing and results have shown that the application is effective and accurate, making it a valuable tool for both language learners and educators. Overall, this project demonstrates the potential of fuzzy logic as a useful approach for language level evaluation, and can be further developed and improved in future work.

8 Additional Resources

The source code and associated files for this project can be found on Github at the following address: `https://github.com/IMHAMEDBOUJEMAA/PROJECT1`. This project contains the Matlab code used to develop the language level evaluation application, as well as the fuzzy system used to evaluate the user's French language skills. My Linked-in `https://www.linkedin.com/in/imhamed-boujemaa-599ba7223/`