International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Fuzzy Logic-Based Decision Support System for Student Admission

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Abstract

This study presents the design and implementation of a Fuzzy Logic-Based Decision Support System (DSS) for student admissions at Christ the King College de Maranding, Inc. (CKCM). Traditional admission processes in many academic institutions rely heavily on rigid thresholds, which often overlook the nuanced characteristics and potentials of student applicants. To address this limitation, the study introduces an intelligent system utilizing a Mamdani-type Fuzzy Inference System (FIS), aiming to provide human-like, objective, and flexible admission decisions.

The proposed system evaluates applicants using three primary criteria: Admission Test Score, Interview Rating, and General Weighted Average (GWA). These inputs are converted into fuzzy linguistic variables through fuzzification, followed by the application of a rule-based evaluation framework. A total of ten expert-formulated rules were defined, capturing realistic decision-making behavior based on institutional standards. Defuzzification, using the centroid method, produces a crisp output score categorizing applicants as Accepted, Waitlisted, or Rejected.

Real data from CKCM's 2024 admission cycle were used for system testing. The results indicate that the system is capable of consistently classifying applicants in a manner that aligns well with expert judgment. High-performing candidates were clearly accepted, while borderline or mixed-profile applicants were accurately identified as waitlisted. The fuzzy system also provided clear grounds for rejection, particularly in cases of low academic and interview performance.

This system enhances transparency, minimizes bias, and strengthens the integrity of the admissions process. While not designed to replace human judgment, it complements decision-making by providing structured, consistent, and explainable outcomes. The study contributes a practical framework for educational institutions seeking to modernize their admission procedures through artificial intelligence techniques.

Keywords: fuzzy logic, decision support system, student admission, Mamdani inference, higher education evaluation

INTRODUCTION

In the field of higher education, the selection of qualified applicants is essential to maintaining academic integrity and institutional reputation. At Christ the King College de Maranding, Inc. (CKCM), the current admission process primarily considers fixed thresholds in examination scores and academic performance. However, these rigid evaluation methods often neglect nuanced applicant qualities such as communication skills or potential for growth, particularly when borderline cases are considered.

Fuzzy Logic provides a solution by modeling imprecise and subjective information in a structured way. It has been proven effective in various educational decision-making scenarios. Specifically, this study employs a Mamdani-type Fuzzy Inference System (FIS) to assess student applications based on three input criteria: Admission Test Score, Interview Rating, and General Weighted Average (GWA). The goal is to classify students into three decision categories: Accepted, Waitlisted, or Rejected.

This approach draws inspiration from studies like Yudono et al. (2022), who demonstrated automated student selection using fuzzy methods, and Aruna et al. (2023), who modeled uncertainties in educational assessment using fuzzy expert systems. With the integration of such a system, CKCM aims to enhance fairness, objectivity, and transparency in its admission process.

LITERATURE REVIEW

Numerous studies have explored the integration of fuzzy logic in educational contexts, particularly in areas of performance evaluation, prediction, and student selection.

Yudono et al. (2022) designed a fuzzy system that improved student admission accuracy by automating selection decisions. Similarly, Aruna et al. (2023) highlighted how fuzzy logic addresses imprecision in performance data. Liu (2021) used fuzzy clustering for performance prediction, which, while not identical, supports the underlying logic of our model.

Herpratiwi et al. (2022) and Wen & Liu (2021) applied fuzzy systems to teaching evaluation and performance assessment without relying on rigid parameters, showing the relevance of linguistic modeling. Tomovic et al. (2025) and Swaroop et al. (2025) emphasized multi-criteria analysis for academic performance using fuzzy sets.

Dhokare et al. (2021) and Gupta et al. (2022) demonstrated how fuzzy models adapt to evolving educational needs. Pujiharsono et al. (2023) and Comendador et al. (2020) established fuzzy logic's value in subjective and mobile-based assessments. Collectively, these works validate fuzzy logic as a robust framework for addressing uncertainty and subjectivity in academic decision-making.

RESEARCH METHODOLOGY

This research uses a Mamdani-type FIS built in MATLAB R2014a. The system evaluates applicants based on three fuzzy input variables:

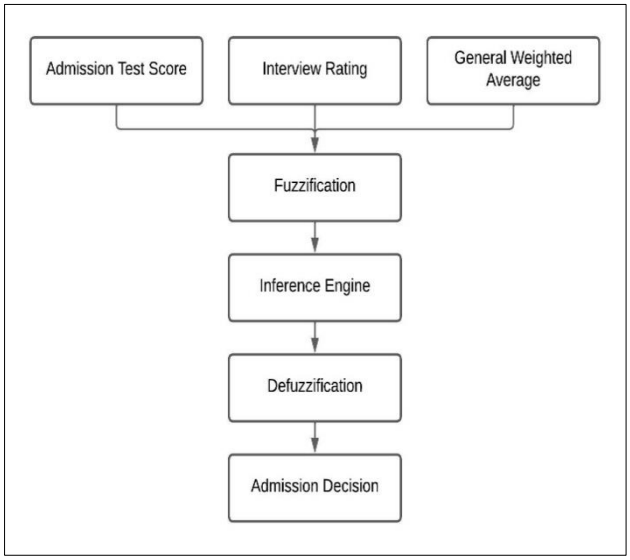

Figure 1. Decision Support System for Student Admissions at CKCM using Fuzzy Design

Fuzzification

Fuzzification is the process of converting crisp input values into fuzzy sets using triangular membership functions. In this system, three input variables—Admission Test Score, Interview Rating, and GWA—are mapped to linguistic values (e.g., Low, Medium, High) using triangular curves (Herpratiwi et al., 2022). This allows partial degrees of membership and supports smoother transitions between levels. For example, a test score of 72 may partially belong to both "Medium" and "High" sets. This flexibility supports a more human-like assessment of student potential.

Table 1. Linguistic variables and categories

No	Variable	Criteria	
1	Admission Test Score	0-50	Low
		40-80	Medium
		70-100	High
2	Interview Rating	0-4	Poor
		3-7	Average
		6-10	Excellent
3	General Weighted Average (lower is better)	1.0-2.5	Excellent
		2.4-3.9	Satisfactory
		3.8-5.0	Unsatisfactory
4	Admission Decision	0-40	Rejected
		30-70	Waitlisted
		60-100	Accepted

1) Admission Test Score

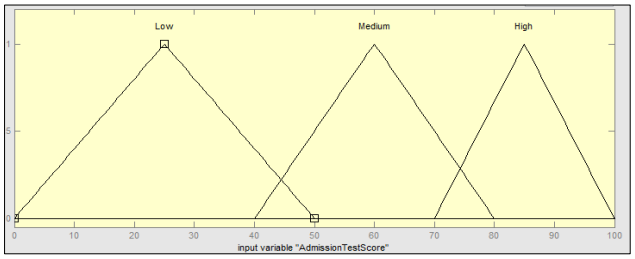

Figure 2. Fuzzy Set of Variables Admission Test Score

2) Interview Rating

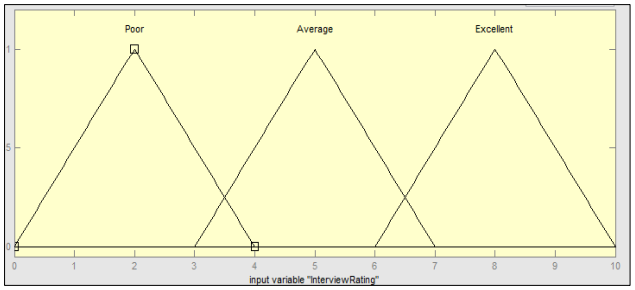

Figure 3. Fuzzy Set of Variables Interview Rating

3) General Weighted Average

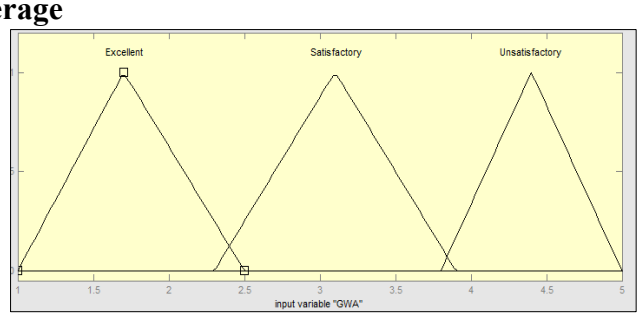

Figure 4. Fuzzy Set of Variables GWA

4) Admission Decision

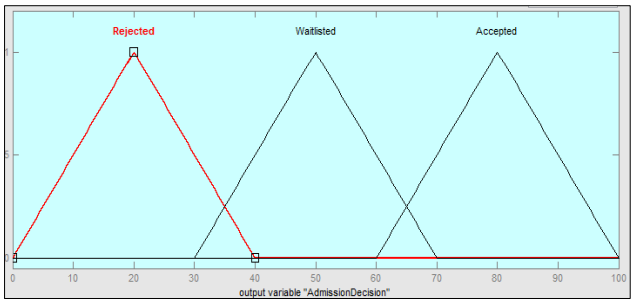

Figure 5. Fuzzy Set of Variables Admission Decision

Evaluation Rules

The evaluation step applies a set of IF-THEN rules to assess combinations of input conditions. Rules are derived from institutional admission policies and faculty expert judgment. These rules enable the inference engine to simulate reasoning patterns and adjust outcomes based on the strength or weakness of individual input factors. Rules allow combinations like "High Test Score" compensating for "Average Interview" when GWA is "Excellent." This aligns with the method used in Yudono et al. (2022) and Tomovic et al. (2025), where human reasoning is modeled into automated decision logic.

Table 2. Evaluation Rules Table

No	IF Condition			THEN Decision
	ATS	IR	GWA	
1	High	Excellent	Excellent	Accepted
2	Medium	Average	Satisfactory	Waitlisted
3	Low	None	Unsatisfactory	Rejected
4	Medium	Excellent	None	Accepted
5	None	Poor	Unsatisfactory	Rejected
6	High	None	Satisfactory	Accepted
7	Medium	None	Excellent	Accepted
8	None	Average	Satisfactory	Waitlisted

9	None	Excellent	Unsatisfactory	Waitlisted
10	Low	Poor	None	Rejected

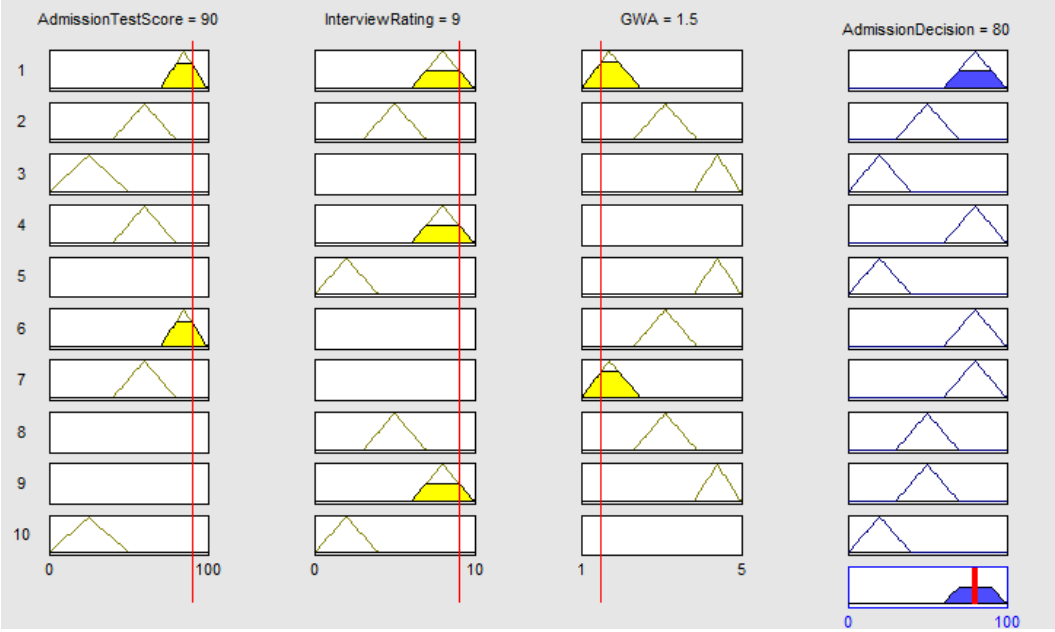

Figure 6. Admission Decision Rules

Defuzzification

Defuzzification converts the fuzzy results generated by the inference engine into a crisp decision score. This study uses the Centroid method, which calculates the center of gravity of the fuzzy output distribution. The resulting score, typically between 0 and 100, determines the final classification: Rejected (0–40), Waitlisted (41–70), or Accepted (71–100). This method provides interpretability and fairness, essential in high-stakes decisions like student admissions Swaroop et al. (2025), Utama et al. (2021).

RESULT

The results of the system, as shown in Table 3, were obtained from actual evaluation trials conducted during the 2024 admission cycle at CKCM. These outcomes demonstrate that the fuzzy system provided consistent, nuanced, and defensible classifications of applicants. High-performing applicants were reliably classified as "Accepted," while applicants with borderline or mixed values were correctly identified as "Waitlisted." Poor performers, especially those with high GWA and low test scores, were marked as "Rejected."

Table 3. Results of the System

Student	ATS	IR	GWA	Decision Score	Classification
S1	90	9	1.5	92	Accepted
S2	65	7	2.2	85.5	Accepted
S3	50	5	3.5	58	Waitlisted

S4	45	4	4.1	35	Rejected
S5	75	6	2.8	72	Accepted
S6	85	3	2.1	66.5	Accepted
S7	60	6	3.9	57	Waitlisted
S8	35	2	4.5	22.5	Rejected
S9	70	8	2.5	88	Accepted
S10	55	7	3.2	61	Waitlisted

DISCUSSION

This confirms the reliability of the rule base and the adaptability of the system to real-world decisions, consistent with the findings of Tomovic et al. (2025) and Swaroop et al. (2025), who highlighted fuzzy logic's role in fair and effective decision modeling in academic contexts.

The fuzzy system succeeded in recognizing potential from compensating strengths, for instance, applicants with average test scores but excellent interviews and academic records. This layered reasoning is similar to the model applied by Yudono et al. (2022), which demonstrated that fuzzy rules could reduce bias in admission selection systems.

The system's ability to handle uncertainty and subjectivity aligns with Aruna et al. (2023), who emphasized the role of fuzzy expert systems in environments with incomplete or vague data, such as student performance or qualitative interviews.

CONCLUSION

The integration of a Fuzzy Logic-based decision support system in the student admission process of Christ the King College de Maranding, Inc. has proven to be both practical and impactful. By analyzing multiple inputs—Admission Test Score, Interview Rating, and GWA—the system provided decisions that align well with both institutional standards and human judgment. The use of a Mamdani-type fuzzy inference model allowed the admissions team to consider not only academic competence but also the applicants' potential and interpersonal strengths.

The results, derived from real admission data, showed that the system consistently produced fair, accurate, and explainable decisions. It identified clear distinctions between high-performing applicants, borderline cases, and those requiring further evaluation. This level of nuance is often difficult to achieve with rigid traditional criteria alone.

For CKCM, this study does more than demonstrate the viability of an automated admission system—it opens the door for data-informed policies and technology-driven decision-making. As the school continues to uphold its mission of holistic education rooted in Catholic values, adopting tools like fuzzy logic supports a more compassionate and balanced approach to evaluating student potential.

This system is not meant to replace human discretion but rather to strengthen it—offering consistency, transparency, and confidence in every decision made for the future members of the CKCM academic community.

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