

Fuzzy Inference System for Diabetes Risk Evaluation with Diet Recommendation

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Problem Statement & Challenges

- A fuzzy-based system that offers transparent, rule-based reasoning for risk prediction and basic lifestyle guidance with minimal diet recommendations.
- Significance : Diabetes is one of the most common chronic diseases that requires early identification of risk to prevent complications. Traditional machine learning models provide good accuracy but lack interpretability.
- Challenges: Medical features (glucose, BMI, blood pressure, insulin) have uncertainty and overlapping ranges, Zero/missing values in the PIMA dataset need imputation, designing meaningful membership functions and fuzzy rules.

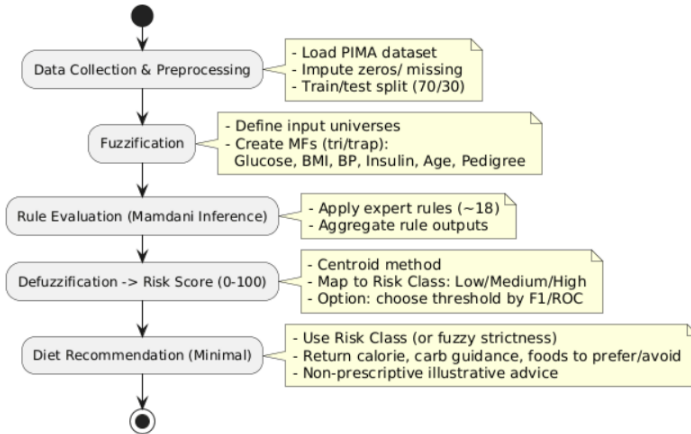
¹Nagaraj, P., Deepalakshmi, P. (2022). An intelligent fuzzy inference rule-based expert recommendation system for predictive diabetes diagnosis. International Journal of Imaging Systems and Technology, 32(4), 1373-1396.

Objective

- Primary objective : Design a transparent and interpretable fuzzy-based system that predicts diabetes risk using clinical attributes such as glucose levels, BMI, blood pressure, insulin, age, and pedigree function.
- Handling Uncertainty and Overlapping Medical Conditions Using Soft Computing Principles - Fuzzy logic helps address this uncertainty by allowing partial memberships instead of rigid thresholds.
- Generate a Continuous Diabetes Risk Score (0–100), then converts it into meaningful categories (Low, Medium, High) using an optimized threshold during testing.
- Provide a minimal and practical diet recommendation system based on the Predicted Risk.

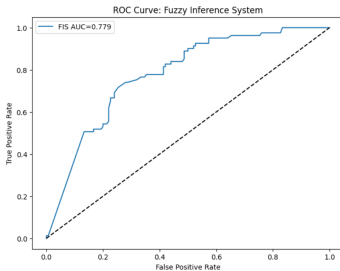
²Abdullah, L. (2017). Identifying risk factors of diabetes using fuzzy inference system. IAES International Journal of Artificial Intelligence, 6(4), 150.

Proposed Method



Comparative Analysis & Results

- FIS continuous score AUC: 0.7795.
- Accuracy=0.7229, Precision=0.5825, Recall=0.7407
- Best threshold by F1: 51 with F1= 0.65537.



- The minimal diet recommender shows how fuzzy outputs can be extended into simple lifestyle guidance.
- The fuzzy inference system successfully predicts diabetes risk in an interpretable manner