

Research on decision support system based on hedge algebra and application in heart failure diagnosis

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Abstract: This study proposes a novel decision support system for heart failure diagnosis, leveraging Hedge Algebras (HA) to address the inherent uncertainty and imprecision in medical data. Traditional diagnostic models often struggle with linguistic variables and fuzzy expert knowledge. By employing HA, the system provides a formal algebraic framework for representing and reasoning with linguistic hedges (e.g., "very," "slightly") and fuzzy terms, enabling a more nuanced quantification of symptoms and risk factors. The methodology involves constructing an HA-based semantic model from clinical guidelines and expert input, which is then integrated into a rule-based inference engine. The system outputs a diagnostic recommendation with a quantified certainty level. Experimental validation using a clinical dataset demonstrates that the HA-based approach achieves high accuracy and interpretability compared to conventional fuzzy logic and machine learning methods. The results confirm that the proposed system effectively supports clinicians in making more reliable and transparent decisions for heart failure diagnosis, offering a robust tool for medical decision-making under uncertainty.

Keywords: hedge algebra, decision support system, heart failure diagnosis, fuzzy logic