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**SP20-BCS-109**

**Assignment 4**

**Computational Intelligence**

To implement a fuzzy control system for COMSATS grading system with the given marks division, GPA calculation, and final grade determination, follow these steps:

**Step 1: Define Linguistic Variables and Membership Functions:**

* Input Variables:
  + Midterm Exam Score: Low, Medium, High
  + Assignments and Quizzes Score: Low, Medium, High
  + Final Exam Score: Low, Medium, High
* Output Variable:
  + Final Grade: Fail, Pass, Merit, Distinction
* Assign appropriate membership functions to each fuzzy set for the input and output variables.

**Step 2: Define Fuzzy Rules:**

* Create fuzzy rules based on expert knowledge or established grading criteria. For Example:
  + Rule 1: If Midterm Exam Score is Low and Assignments and Quizzes Score is Low and Final Exam Score is also Low, then Final Grade is Fail.
  + Rule 2: If Midterm Exam Score is Medium and Assignments and Quizzes Score is Medium and Final Exam Score is Medium, then Final Grade is Pass.
  + Rule 3: If Midterm Exam Score is High and Assignments and Quizzes Score is High and Final Exam Score is High, then Final Grade is Distinction.
  + Rule 4: If Midterm Exam Score is Low and Assignments and Quizzes Score is High and Final Exam Score is High, then Final Grade can be Pass as well.
  + Rule 5: If Midterm Exam Score is Low and Assignments and Quizzes Score is Medium and Final Exam Score High, then Final Grade can be Pass.

**Step 3: Fuzzy Inference:**

* Given the inputs (Midterm Exam Score, Assignments and Quizzes Score, Final Exam Score), evaluate the degree of membership of each input variable to the fuzzy sets using the membership functions.

**Step 4: Apply Fuzzy Rules:**

* Use the fuzzy rules to determine the firing strength of each rule based on the degree of membership of the antecedents (input conditions).

**Step 5: Aggregate Fuzzy Outputs:**

* Combine the firing strengths of the rules to obtain the aggregated fuzzy output.

**Step 6: Defuzzification:**

* Convert the aggregated fuzzy output into a crisp value (Final Grade) using defuzzification methods such as the centroid, weighted average, or maximum membership.

**Step 7: Calculate GPA:**

* Once you have obtained the Final Grade, map it to a corresponding GPA based on the university's grading scale.
* Determine the GPA calculation formula based on the university's policy. For example, you may assign specific GPA values to each grade (e.g., Fail: 0.0, Pass: 2.0, Merit: 3.5, Distinction: 4.0) and calculate the GPA by taking the weighted average of the grades according to the marks division (25% Midterm Exam + 25% Assignments and Quizzes + 50% Final Exam).

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