

## Mid Semester Examination

Course Name: Artificial Intelligence  
Full Marks-30

Code: CS561/CS571  
Time: 2 hours

*Answer ALL the questions*

*Make reasonable assumptions as and whenever necessary. You can answer the questions in any sequence. However, the answers to all the parts of any particular question should appear together.*

(Q1). Fuzzy subset hood and fuzzy implication are defined as follows by (1) and (2) respectively:

$$\begin{aligned} \text{Sub}(B, A) &= 1 - \text{Sup}(B, A) \\ &= 1 - \frac{\sum_{x_i \in U} \max(0, \mu_B(x_i) - \mu_A(x_i))}{\sum_{x_i \in U} \mu_B(x_i)} \quad \text{where } U = \{x_1, x_2, \dots, x_n\} \end{aligned} \quad (1)$$

$$t(\mu_B(x_i) \rightarrow \mu_A(x_i)) = \min(1, 1 - t(\mu_B(x_i)) + t(\mu_A(x_i))) \quad (2)$$

where  $U$  is the universe,  $A$  and  $B$  are fuzzy sets,  $\mu_S(x)$  is membership value  $([0,1])$  of element  $x$  in  $S$ . (2) is also called the Lukasiewicz operation, where  $t$  indicates the amount of truth  $([0,1])$ .

Since logic and set theory are interdependent and consistent with each other, (1) and (2) also have to be mutually consistent. Establish this. **12 marks**

(Q2). Define monotonicity with respect to  $A^*$  search. Prove that if  $A^*$  has picked a node for expansion, the optimal path to that node has been found and its parent pointer will not have to be changed in future, provided the heuristic function is monotonic. **8 marks**

(Q3) (a). "Simulated Annealing could be an alternative solution to address all the problems that a Hill climbing search encounters"- Justify in favour or against this claim with proper explanations. **2 marks**

(b). Consider a Multinomial Naïve Bayes classifier for document classification. With respect to this, explain with appropriate examples the (i). importance of conditional independence assumption in modelling the problem; (ii). problems that (i) encounters; (iii). possible remedial measures of (ii); and (iv). the necessity of considering the number of occurrences of terms (or words) for classification. **8 marks**