

Introduction to Fuzzy Logic



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Fuzzy Logic

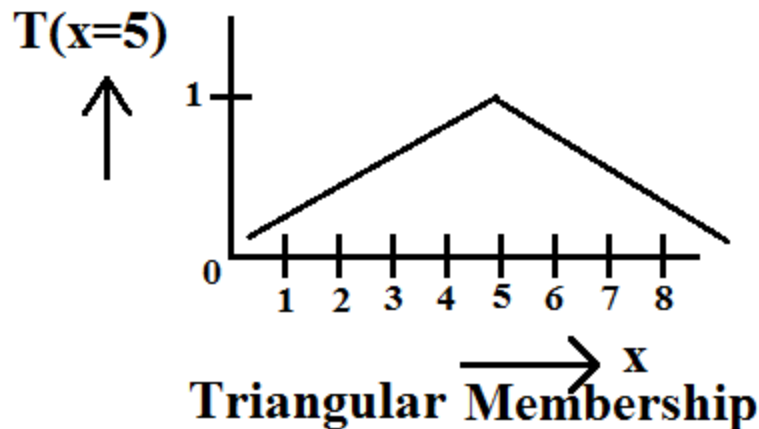
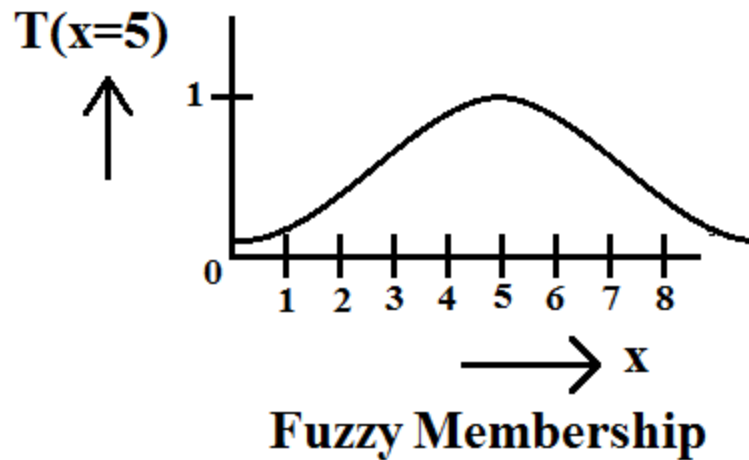
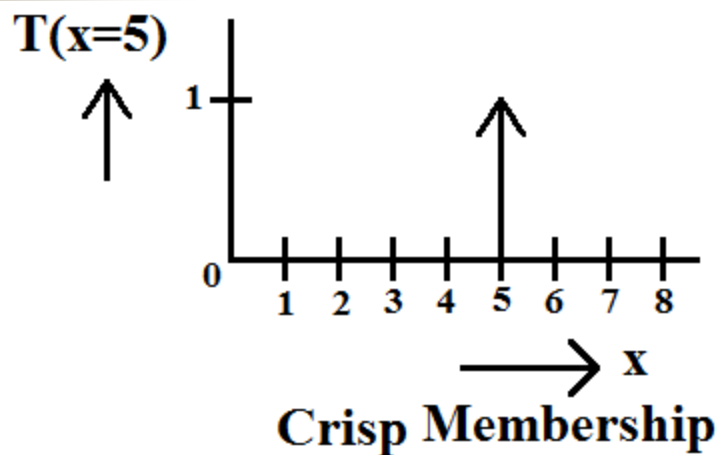
- Started with Fuzzy Sets by Zadeh in 1965
- $A = \{a, b, c, d, e\}, a \in A$ but $g \notin A$
- Does Mr. X belong to the set of tall people?
 - Neither “YES” nor “NO”
 - Degree of belongingness
- Height, Intelligence, Beauty, etc. are matters of degrees
 - Highly subjective



Truth as a Matter of Degree

- Is $5 = 5$? Yes, $T(5=5) = 1$
- Is $4 = 5$? No, $T(4=5) = 0$
- Is $3 = 5$? Still No, $T(3=5) = 0$
- Shouldn't $T(4=5)$ be different from $T(3=5)$?
- What about $T(4.9999=5)$ versus $T(\infty = 5)$?
- Degree of belongingness is the Membership Value in Fuzzy Logic

Membership Functions





Fuzzy Logic versus Binary Logic

- Binary Logic operates in just 0 and 1
 - *There are 10 kinds of people, one who know binary and the other who do not*
- Success of Binary Logic: Digital Computer
- Binary Logic: a special case of Fuzzy Logic
- AND, OR and NOT operations in Binary are MIN, MAX and $(1-x)$ operations in Fuzzy Logic (to begin with).

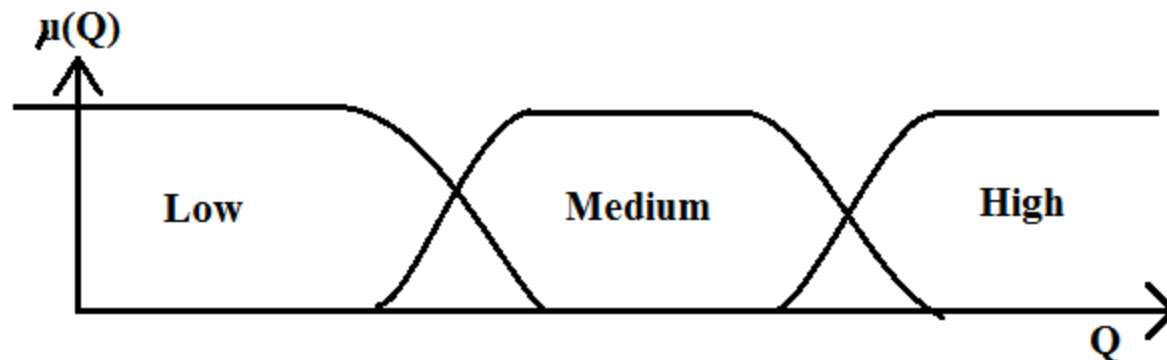


Fuzzy Logic in Real Life

- Caters to uncertain/ambiguous situations
- Leads to Artificial Intelligence (AI)
 - Machine: That which makes work easy
 - Automation, Programmability, Self Decision Making Capability, need for AI
- Computing with Words
- Example: Fuzzy Logic in Washing Machines

Fuzzy Logic versus Probability

- $\mu(\text{Water}) = 0.7$ versus $p(\text{Water}) = 0.7$
- Realistic Example
 - Ring Road versus Traffic Lights
- $\sum \text{probability} = 1$
- Not necessarily so for Membership Values





Probability

- A very good tool for modeling
- Real meaning of probability?
 - $p(\text{Head}) = 0.5$?
 - A realistic case of misunderstanding
 - Do not abuse the notion of probability
- Choice of Probability Distribution
 - Must be corroborated with the real data



Thanks!

Questions?