

Differentiate b/w fuzzification and Defuzzification

	Fuzzification	Defuzzification
1.	Converts crisp numerical inputs into fuzzy linguistic terms using membership functions.	Converts fuzzy output sets into a single crisp value that can be practically applied.
2.	Occurs at the input stage of the fuzzy inference system.	Occurs at the output stage of the fuzzy inference system.
3.	Works with measured, real-world data (e.g., temperature, speed).	Works with fuzzy reasoning results generated after inference.
4.	To make precise data interpretable by fuzzy logic for reasoning.	To make fuzzy reasoning results usable for real-world control or decision-making.
5.	Uses membership functions (triangular, trapezoidal, Gaussian, etc.) to assign degrees of belonging.	Uses defuzzification methods (centroid, mean of maxima, bisector, etc.) to compute a crisp output value.

Example:

1: Input: Take input in CRISP format, like a sensor reads a precise numerical temperature =30°C.

2: Fuzzification Process: It converts the CRISP input into fuzzy linguistic categories with degrees of membership, like:

$$30^{\circ}\text{C} \rightarrow \left\{ \begin{array}{l} \text{Cold: 0.0,} \\ \text{Warm: 0.7,} \\ \text{Hot: 0.3} \end{array} \right\}$$

3: Applying Inference(Rule): Now the fuzzy rule processing and reasoning occurs, like:

IF *Temperature is Warm*
THEN

Fan Speed is Medium

4: Defuzzification Process: It converts fuzzy outputs into a single crisp, actionable control signal, i.e.

$$\{\text{Slow: 0.2, Medium: 0.6, Fast: 0.4}\} \rightarrow \text{Fan Speed} = 65\%$$