

# Árvores de Decisão

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## 1 Fuzzy Controller Example

Imagine you have a basic heating system in a room, and you want to control the temperature to keep it comfortable. A fuzzy controller can be designed to adjust the heater's intensity based on the current room temperature and desired setpoint temperature.

Here are the key components of this fuzzy controller:

### 1. Inputs:

- (a) Error ( $e$ ): Difference between the desired setpoint temperature and the current room temperature.
- (b) Rate of Change of Error ( $\Delta e$ ): How quickly the temperature is changing.

### 2. Outputs:

- (a) Heater Intensity: A value representing how strong the heater should be, ranging from low to high.

### 3. Fuzzy Sets:

- (a) Error has fuzzy sets: Negative Big (NB), Negative Medium (NM), Zero (ZE), Positive Medium (PM), Positive Big (PB).
- (b) Rate of Change of Error has fuzzy sets: Negative (N), Zero (Z), Positive (P).
- (c) Heater Intensity has fuzzy sets: Low (L), Medium (M), High (H).

### 4. Fuzzy Rules:

- (a) IF Error is NB AND  $\Delta e$  is N, THEN Heater Intensity is H.
- (b) IF Error is NM AND  $\Delta e$  is N, THEN Heater Intensity is M.
- (c) IF Error is ZE AND  $\Delta e$  is N, THEN Heater Intensity is M.
- (d) IF Error is PM AND  $\Delta e$  is N, THEN Heater Intensity is L.
- (e) IF Error is PB AND  $\Delta e$  is N, THEN Heater Intensity is L.
- (f) IF Error is NB AND  $\Delta e$  is Z, THEN Heater Intensity is H.
- (g) IF Error is NM AND  $\Delta e$  is Z, THEN Heater Intensity is M.
- (h) IF Error is ZE AND  $\Delta e$  is Z, THEN Heater Intensity is M.
- (i) IF Error is PM AND  $\Delta e$  is Z, THEN Heater Intensity is M.
- (j) IF Error is PB AND  $\Delta e$  is Z, THEN Heater Intensity is L.
- (k) IF Error is NB AND  $\Delta e$  is P, THEN Heater Intensity is M.
- (l) IF Error is NM AND  $\Delta e$  is P, THEN Heater Intensity is M.

- (m) IF Error is ZE AND  $\Delta e$  is P, THEN Heater Intensity is L.
- (n) IF Error is PM AND  $\Delta e$  is P, THEN Heater Intensity is L.
- (o) IF Error is PB AND  $\Delta e$  is P, THEN Heater Intensity is L.

5. Fuzzy Inference and Defuzzification:

- (a) Use fuzzy logic to determine the degree to which each rule's conclusion applies based on the input variables.
- (b) Combine the rule conclusions to obtain a fuzzy output distribution.
- (c) Defuzzify the fuzzy output distribution to obtain a crisp value for Heater Intensity.