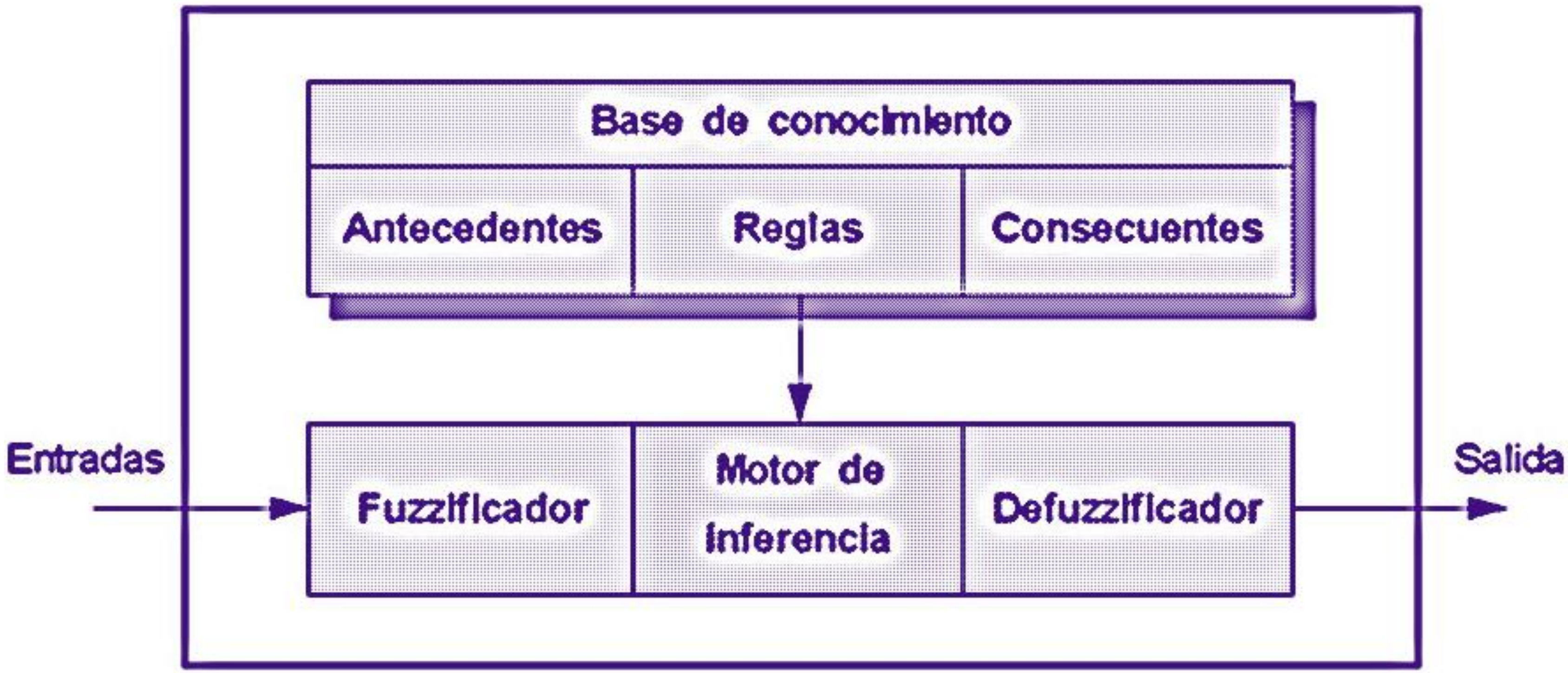
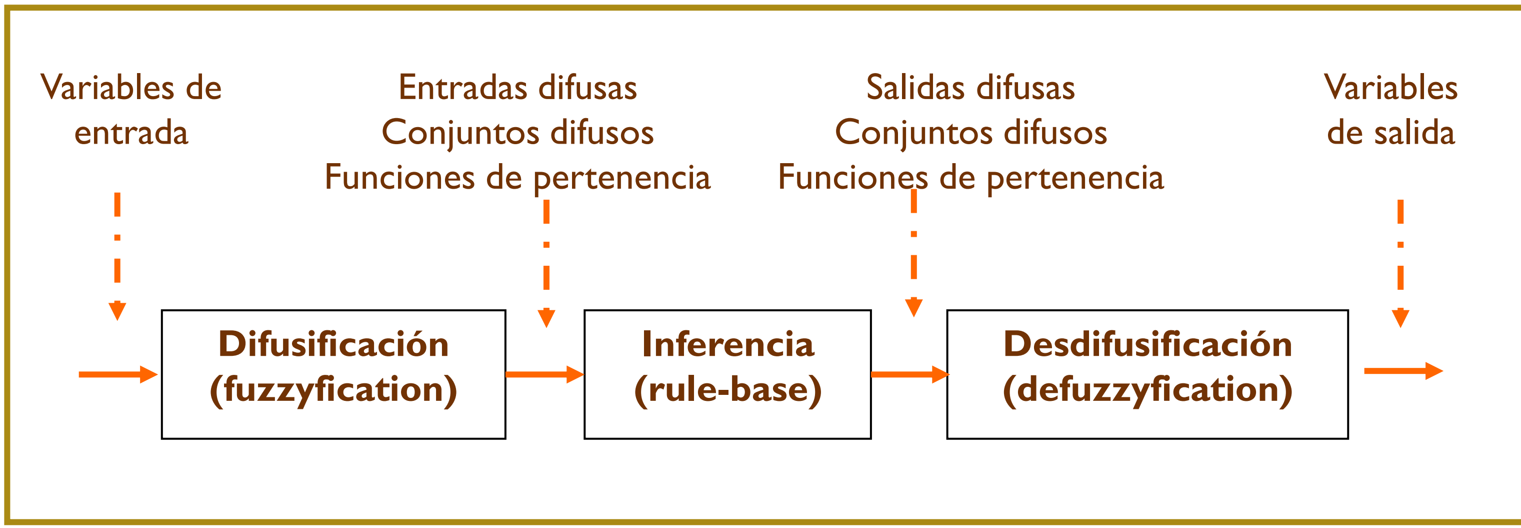
DEFUZZIFICACIÓN A ESCALARES

Dra. Sandra Luz Canchola M.

Defuzzificador



ALGORITMO DE LÓGICA FUZZY



CORTE LAMBDA DE CONJUNTOS DIFUSOS

$$\mathrm{A}_\lambda = \{x \mid \mu_{\underset{\sim}{\mathrm{A}}}(x) \geq \lambda\}$$

$$\underset{\sim}{\mathrm{A}} = \left\{ \frac{1}{a} + \frac{0.9}{b} + \frac{0.6}{c} + \frac{0.3}{d} + \frac{0.01}{e} + \frac{0}{f} \right\}$$

$$\mathrm{A}_1 = \{a\}, \qquad \mathrm{A}_{0.9} = \{a, b\}$$

$$\mathrm{A}_{0.6} = \{a, b, c\}, \qquad \mathrm{A}_{0.3} = \{a, b, c, d\}$$

$$\mathrm{A}_{0+} = \{a, b, c, d, e\}, \qquad \mathrm{A}_0 = \mathrm{X}$$

CORTE LAMBDA DE CONJUNTOS DIFUSOS

1. $(\underset{\sim}{\mathrm{A}} \cup \underset{\sim}{\mathrm{B}})_\lambda = \mathrm{A}_\lambda \cup \mathrm{B}_\lambda$

2. $(\underset{\sim}{\mathrm{A}} \cap \underset{\sim}{\mathrm{B}})_\lambda = \mathrm{A}_\lambda \cap \mathrm{B}_\lambda$

3. $(\overline{\underset{\sim}{\mathrm{A}}})_\lambda \neq \overline{A}_\lambda$ except for a value of $\lambda = 0.5$

4. For any $\lambda \leq \alpha$, where $0 \leq \alpha \leq 1$, it is true that $\mathrm{A}_\alpha \subseteq \mathrm{A}_\lambda$, where $\mathrm{A}_0 = X$

CORTE LAMBDA PARA RELACIONES DIFUSAS

$$\mathrm{R}_\lambda = \{(x, y) \mid \mu_{\mathrm{R}}(x, y) \geq \lambda\}$$

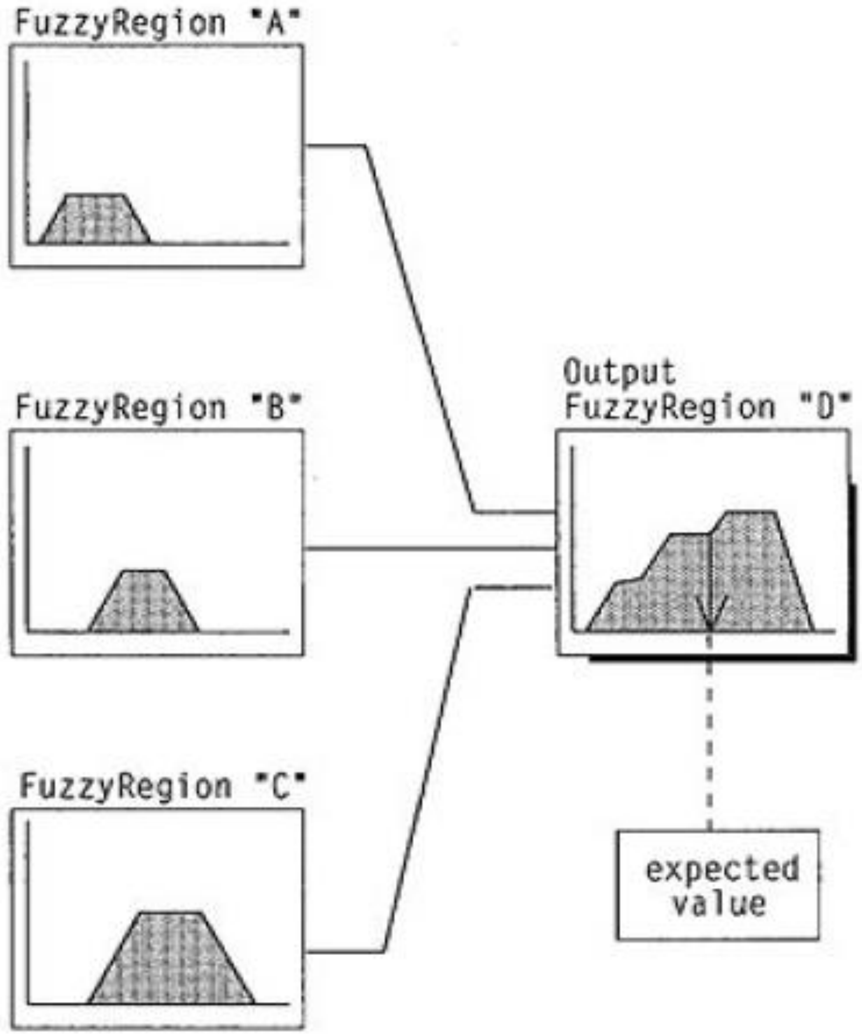
$$\underset{\sim}{\mathrm{R}} = \begin{bmatrix} 1 & 0.8 & 0 & 0.1 & 0.2 \\ 0.8 & 1 & 0.4 & 0 & 0.9 \\ 0 & 0.4 & 1 & 0 & 0 \\ 0.1 & 0 & 0 & 1 & 0.5 \\ 0.2 & 0.9 & 0 & 0.5 & 1 \end{bmatrix}$$

CORTE LAMBDA PARA RELACIONES DIFUSAS

$$\lambda = 1,\ R_1 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\lambda = 0.9,\ R_{0.9} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

DEFUZZIFICACION



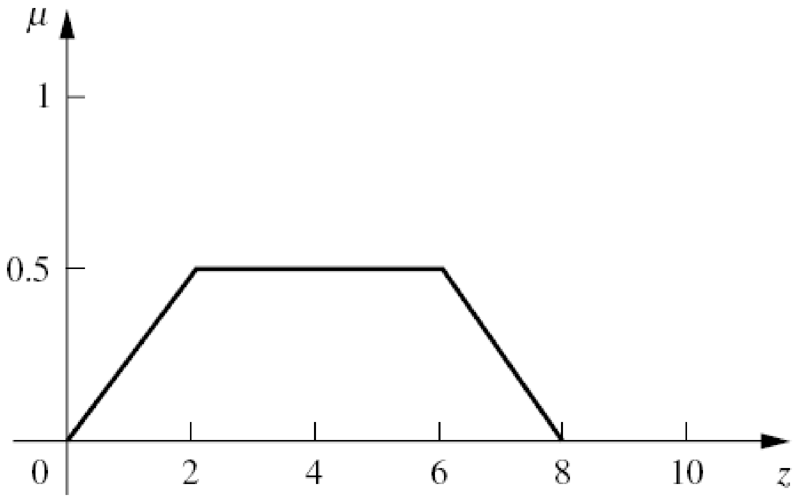
Agregación de conjuntos difusos y el proceso de defuzificación.

1. METODO DEL PRINCIPIO DE MEMBRESÍA MÁXIMA.

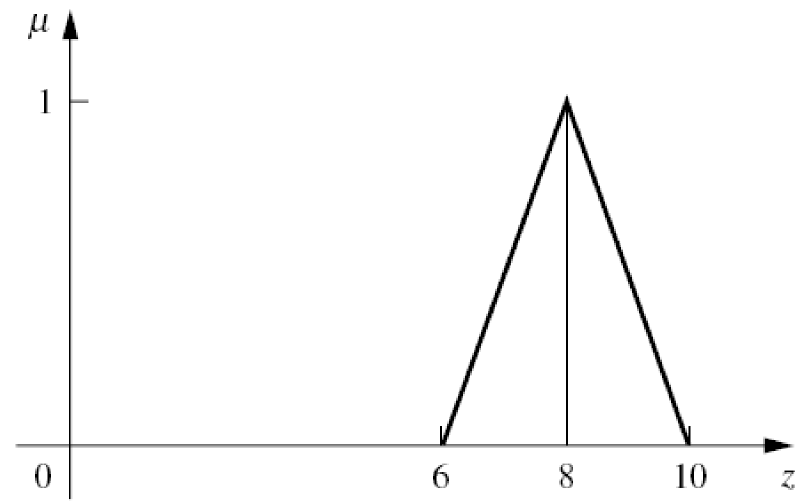
$$\mu_{\underset{\sim}{C}}(z^*) \geq \mu_{\underset{\sim}{C}}(z) \qquad \text{for all } z \in Z$$

Donde z* representa el valor defuzzificado.

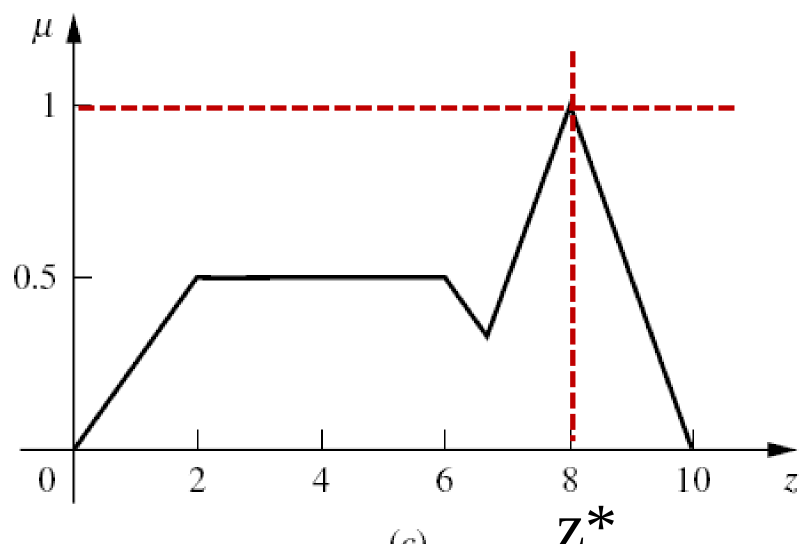
1. METODO DEL PRINCIPIO DE MEMBRESÍA MÁXIMA.



(a)



(b)



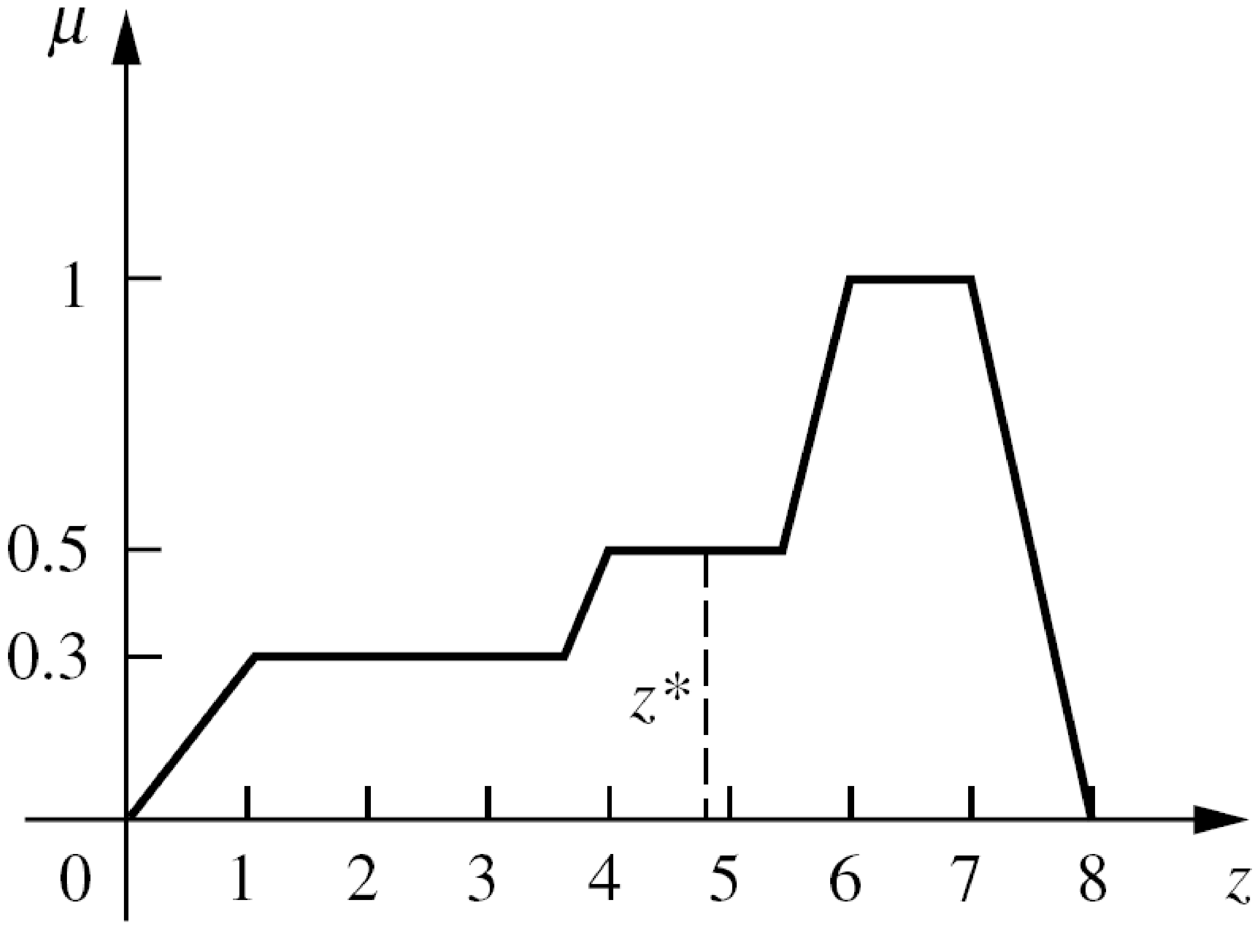
(c)

II. MÉTODO CENTROIDE

$$z^{*} = \frac{\int \mu_c(z) \bullet z dz}{\int \mu_c(z) dz}$$

$$z^{*} = \frac{\sum_{i=1}^{n} \mu_c(z_i) \bullet z_i}{\sum \mu_c(z_i)}$$

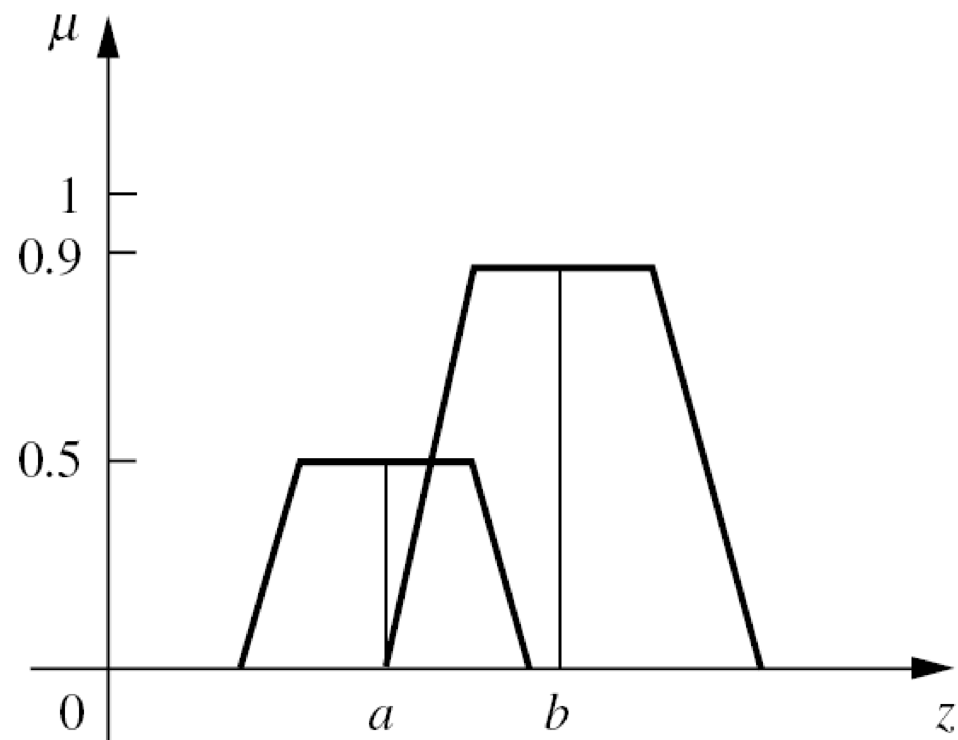
II. MÉTODO CENTROIDE



III. METODO DEL PROMEDIO PONDERADO

$$z^* = \frac{\sum \mu_{\underset{\sim}{C}}(\bar{z}) \cdot \bar{z}}{\sum \mu_{\underset{\sim}{C}}(\bar{z})}$$

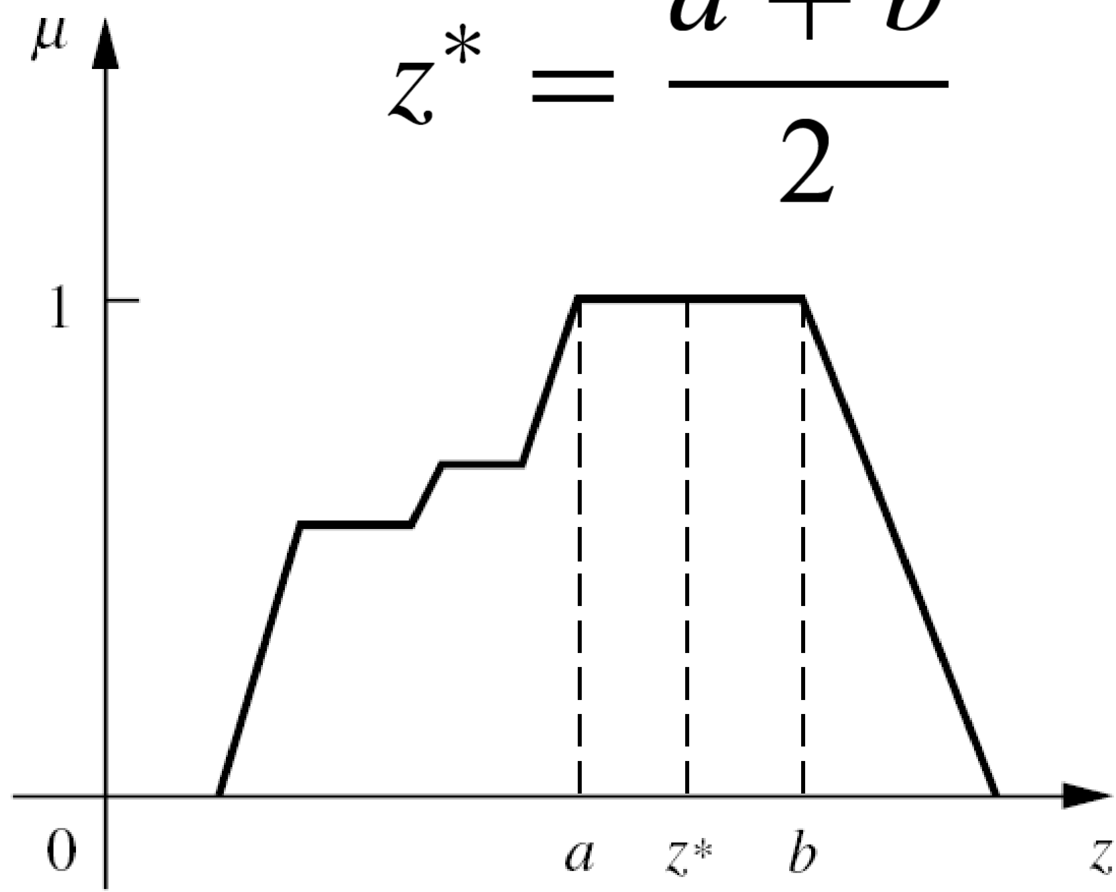
$$z^* = \frac{a(0.5) + b(0.9)}{0.5 + 0.9}$$



IV. METODO DE MEMBRESÍA MEDIA MÁXIMA

- Cuando los puntos máximos son diversos.

$$z^* = \frac{a+b}{2}$$

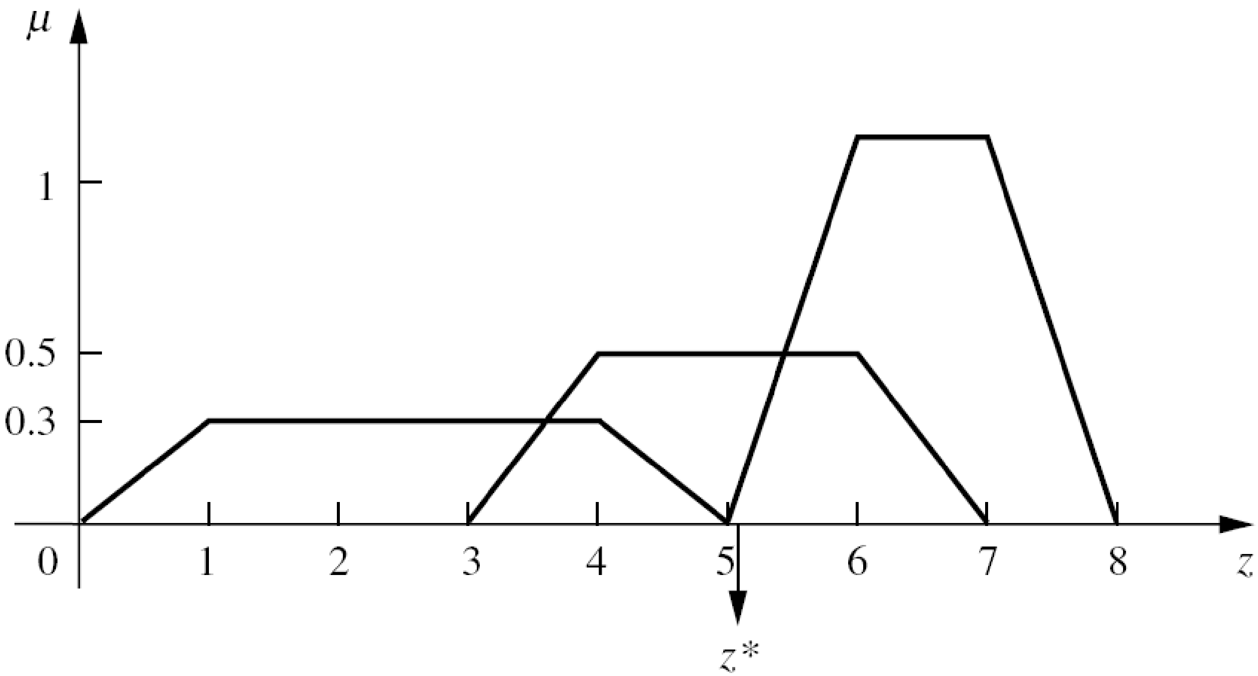


V. MÉTODO CENTRO DE SUMAS

$$z^* = \frac{\int_Z \bar{z} \sum_{k=1}^{n} \mu_{\underset{\sim}{C}_k}(z)\, \mathrm{d}z}{\int_z \sum_{k=1}^{n} \mu_{\underset{\sim}{C}_k}(z)\, \mathrm{d}z}$$

$$z^* = \frac{\sum_{i=1}^{n} z_i * 0.5 * \mu_i(z_i) * (area_{\max} + area_{soporte})}{\sum_{i=1}^{n} 0.5 * \mu_i(z_i) * (area_{\max} + area_{soporte})}$$

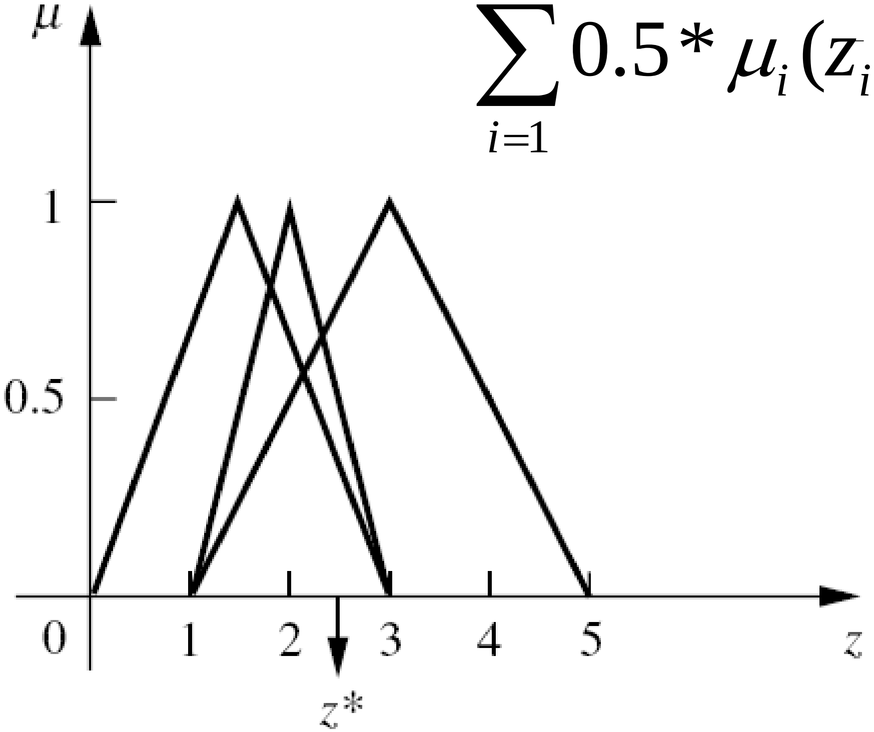
V. MÉTODO CENTRO DE SUMAS



$$z^* = \frac{[2.5 \times 0.5 \times 0.3(3+5) + 5 \times 0.5 \times 0.5(2+4) + 6.5 \times 0.5 \times 1(3+1)]}{[0.5 \times 0.3(3+5) + 0.5 \times 0.5(2+4) + 0.5 \times 1(3+1)]}$$

$$= 5.0 \text{ m}$$

$$z^* = \frac{\sum_{i=1}^{n} z_i * 0.5 * \mu_i(z_i) * area_{soporte}}{\sum_{i=1}^{n} 0.5 * \mu_i(z_i) * area_{soporte}}$$

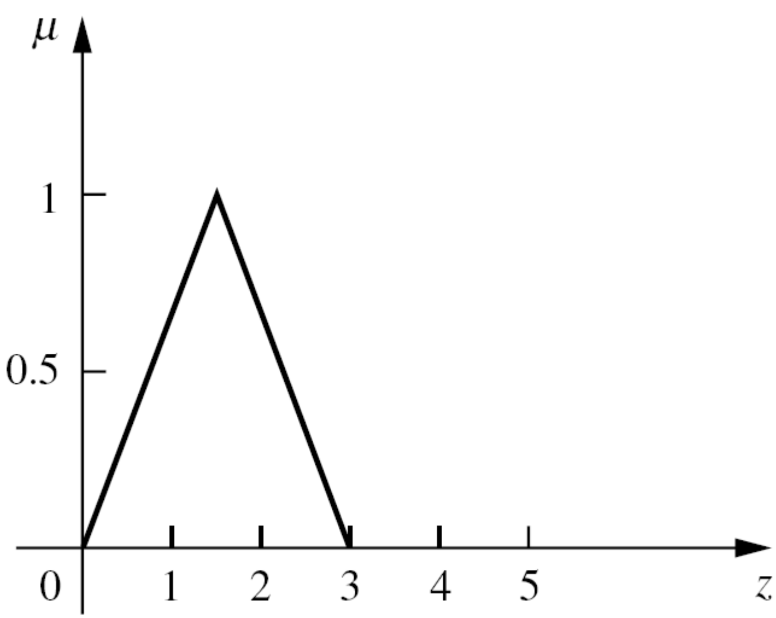


$$z^* = \frac{(0.5 \times 3 \times 1 \times 1.5 + 0.5 \times 2 \times 1 \times 2 + 0.5 \times 4 \times 1 \times 3)}{(0.5 \times 3 \times 1 + 0.5 \times 2 \times 1 + 0.5 \times 4 \times 1)} = 2.3 \text{ m}$$

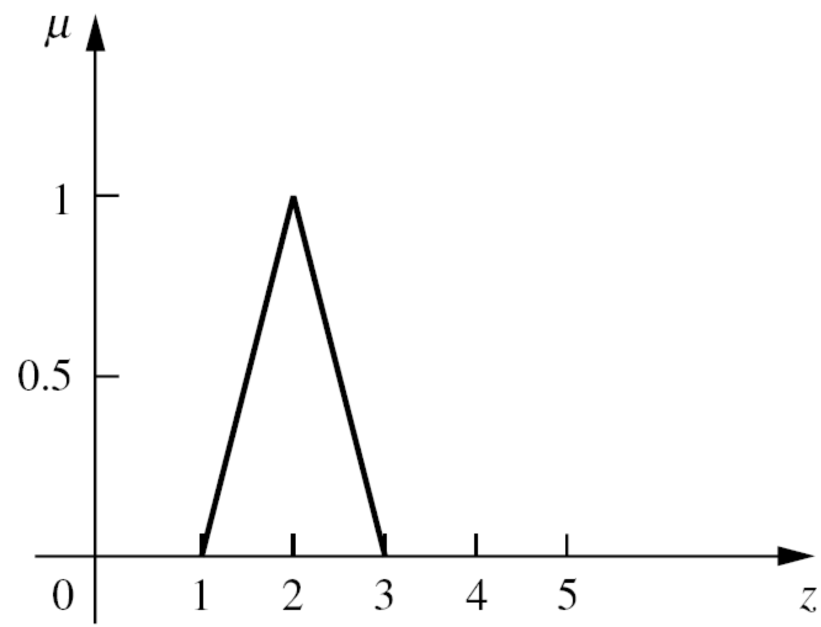
PRACTICA 3

1. Dados tres conjuntos B_1, B_2 y B_3. Calcular el valor esperado z* aplicando los métodos:

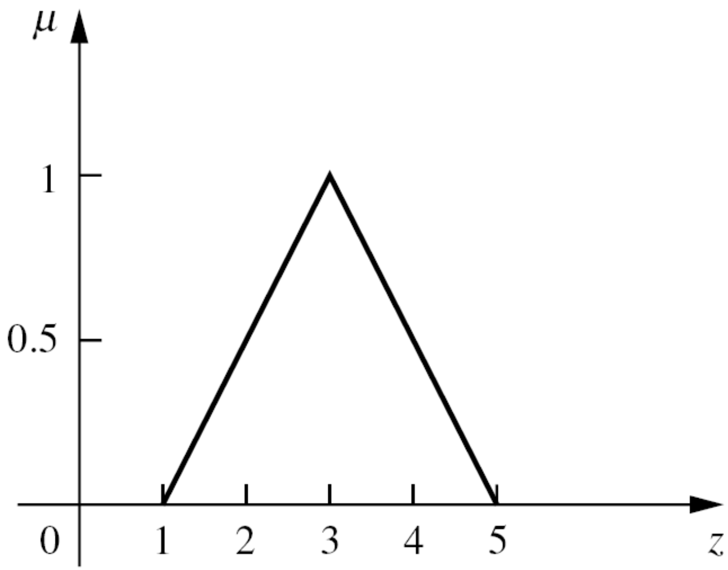
   a) Principio de membresía máxima.
   b) Centroide.
   c) Promedio ponderado.
   d) Centro de sumas.
   e) Membresía media máxima.



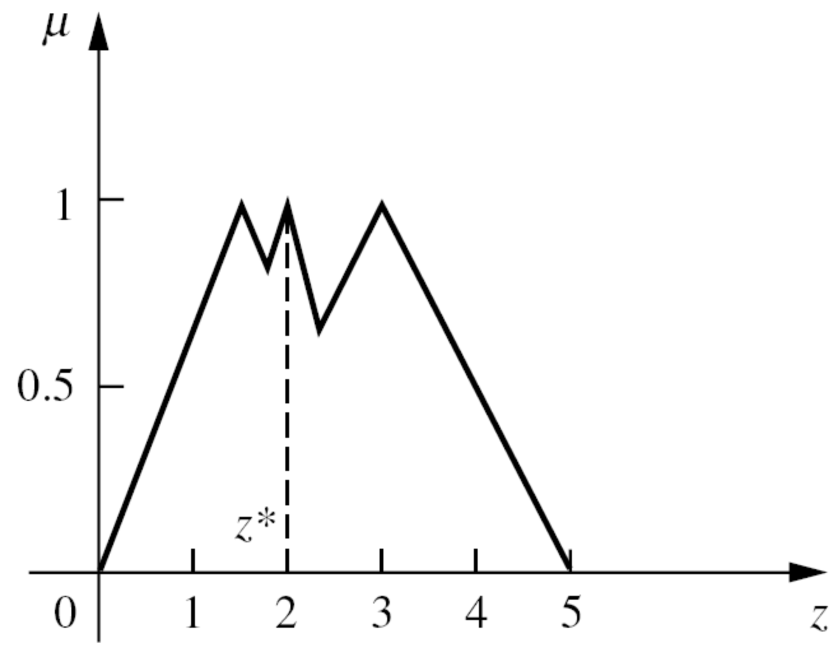
a) B_1



b) B_2



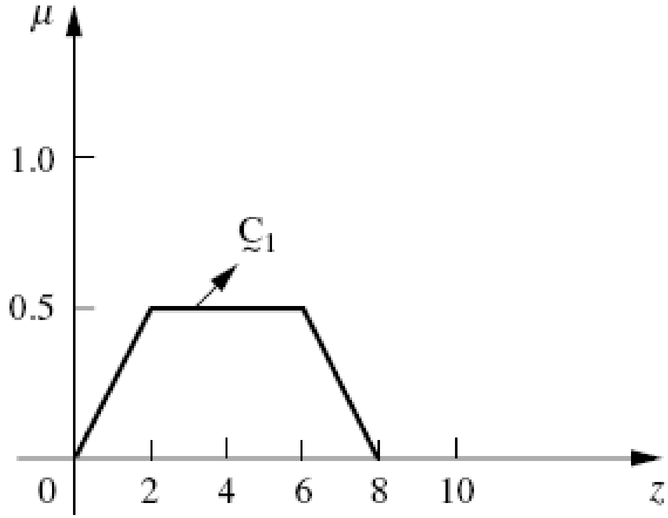
c) B_3



d) Composición

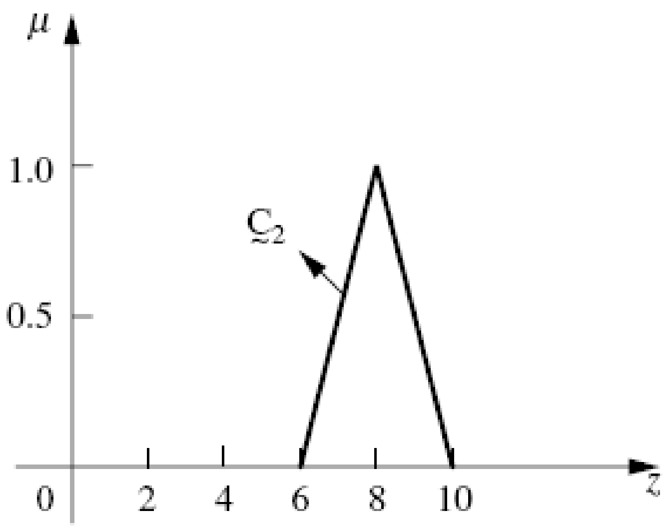
2. Dados tres conjuntos C_1, y C_2. Calcular el valor esperado z* aplicando los métodos:

a) Principio de membresía máxima.
b) Centroide.
c) Promedio ponderado.
d) Centro de sumas.
e) Membresía media máxima.



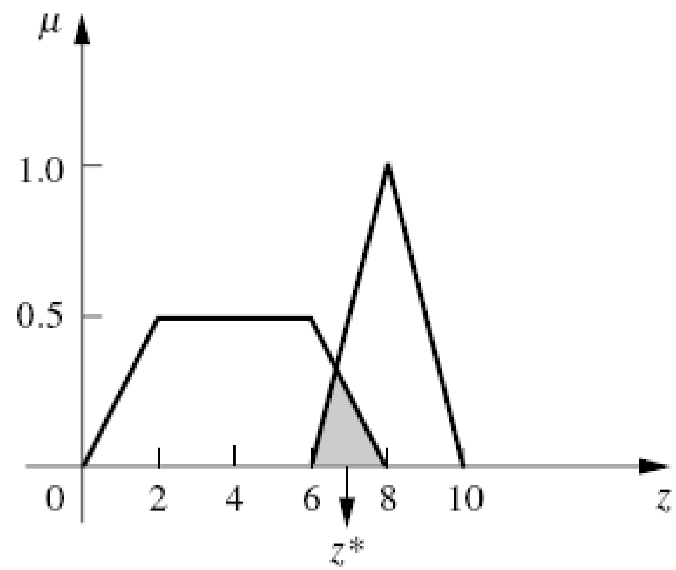
μ
1.0
0.5
$\underset{\sim}{C}_1$
0
2
4
6
8
10
z

(a)



μ
1.0
0.5
$\underset{\sim}{C}_2$
0
2
4
6
8
10
z

(b)



μ
1.0
0.5
0
2
4
6
8
10
z
z*

(c)

BIBLIOGRAFÍA

- Fuzzy Logic with Engineering Applications. Timothy J. Ross. John Wiley & Sons, Ltd. Edición 2. 2004. Capítulo 5.