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Q6 A] (ii)

Fuzzy Inference system (FIS):

- Fuzzy inference system is the key unit of a fuzzy logic system having decision making as its primary work.
- It uses the 'IF_THEN' rules along with connectors "OR" or "AND" for drawing essential decision rules.

Characteristics:

- The output from FIS is always a fuzzy set irrespective of its input which can be fuzzy.
- It is necessary to have fuzzy output when it is used as a controller.
- A defuzzification unit would be there with FIS to convert fuzzy variables into crisp variables.

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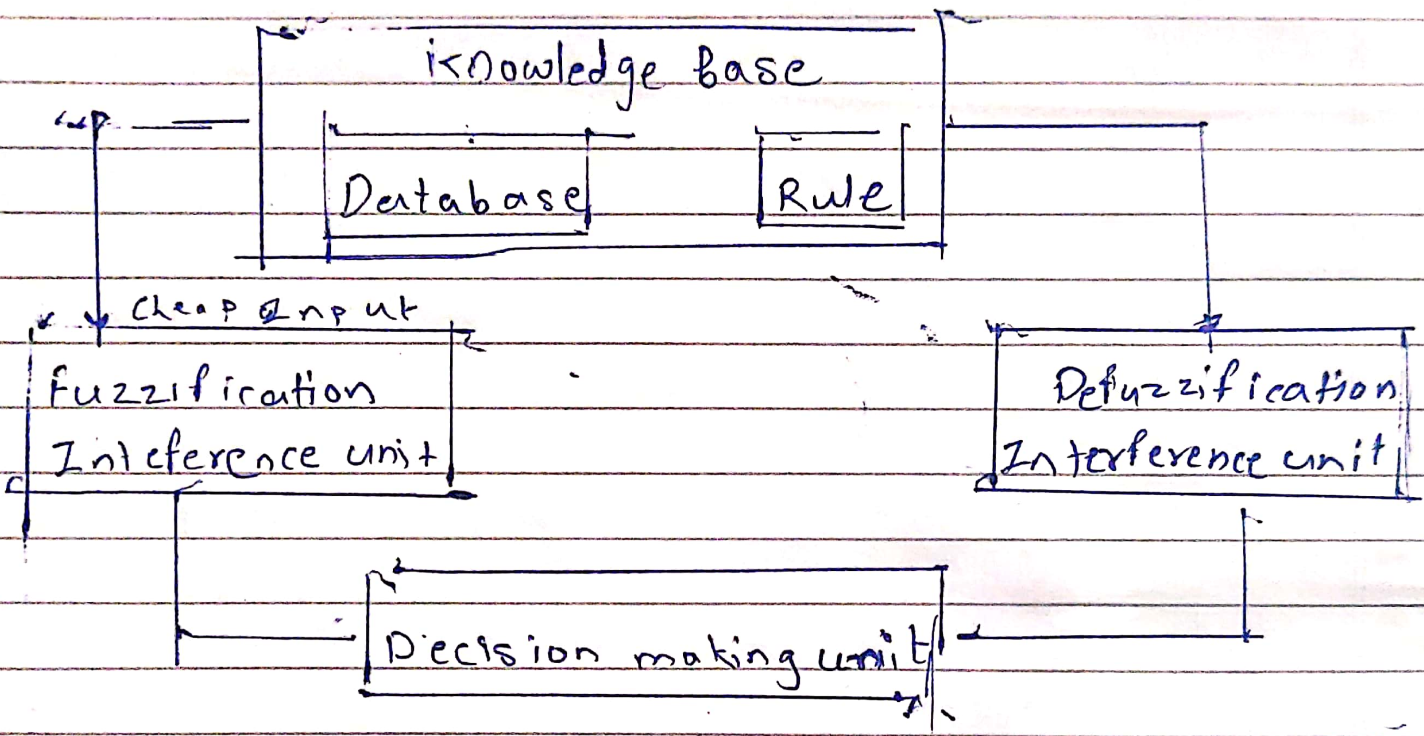
FIS Architecture



FIS Architecture

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Functional Blocks of FIS:

(1) Rule Base

- It contains fuzzy IF-THEN rules

(2) Database

- It defines the membership function of fuzzy sets used in fuzzy rules

(3) Decision Making Unit:

- It performs operation on rules

(4) Fuzzification Interface Unit:

- It converts the crisp quantities into fuzzy quantities.

(5) Defuzzification Interface Unit:

- It converts the fuzzy quantities into crisp quantities.

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Working

- A fuzzification unit supports the application of numerous fuzzification methods and converts the crisp input into fuzzy input.
- A knowledge base collection of rule base and database is formed upon the conversion of crisp input into fuzzy input.
- The defuzzification unit fuzzy input is finally converted into crisp output.

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Q5 B] (ii)

(a) Max - min composition.

$$R = \begin{array}{c|cc} & y_1 & y_2 \\ \hline x_1 & 0.6 & 0.2 \\ x_2 & 0.3 & 0.9 \end{array} \qquad S = \begin{array}{c|ccc} & z_1 & z_2 & z_3 \\ \hline y_1 & 1 & 0.5 & 0.3 \\ y_2 & 0.8 & 0.4 & 0.7 \end{array}$$

Max - min composition : $T = R \cdot S$

$$\mu_T(x_1, z_1) = \max[\min(0.6, 1), \min(0.2, 0.8)]$$
$$= \max[0.6, 0.2]$$
$$= 0.6$$

$$\mu_T(x_1, z_2) = \max[\min(0.6, 0.5), \min(0.3, 0.4)]$$
$$= \max[0.5, 0.3]$$
$$= 0.5$$

$$\mu_T(x_1, z_3) = \max[\min(0.6, 0.3), \min(0.2, 0.7)]$$
$$= \max[0.3, 0.8]$$
$$= 0.3$$

$$\mu_T(x_2, z_1) = \max[\min(0.3, 1), \min(0.9, 0.8)]$$
$$= \max[0.3, 0.4]$$
$$= 0.4.$$

$$\mu_T(x_2, z_2) = \max[\min(0.3, 0.5), \min(0.9, 0.4)]$$
$$= \max[0.3, 0.4]$$
$$= 0.4$$

$$\mu_T(x_2, z_3) = \max[\min(0.3, 0.3), \min(0.9, 0.7)]$$
$$= \max[0.3, 0.7]$$
$$= 0.7.$$

$$\therefore T = R \cdot S = \begin{array}{c|ccc} & z_1 & z_2 & z_3 \\ \hline x_1 & 0.6 & 0.5 & 0.3 \\ x_2 & 0.8 & 0.4 & 0.7 \end{array}$$

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(5) Max Product Composition

$$T_2 = R \circ S : \begin{array}{c|c} & \begin{array}{ccc} y_1 & y_2 & y_3 \end{array} \\ \begin{array}{c} x_1 \\ x_2 \end{array} & \begin{bmatrix} - & & \\ & & \end{bmatrix} \end{array}$$

For values of x_1, y_1:

$= \max [(x_1, y_1)_R * (x_1, y_1)_S] [(x_1, y_2)_R * (x_2, y_2)_S]$

$= \max [[0.6 * 1] \quad [0.2 * 0.8]]$

$= \max [0.6, \; 0.16]$

$= \underline{0.6}$

Similarly other values can be determined and the resultant matrix is

$$T_2 = \begin{bmatrix} 0.6 & 0.3 & 0.18 \\ 0.72 & 0.36 & 0.9 \end{bmatrix}$$