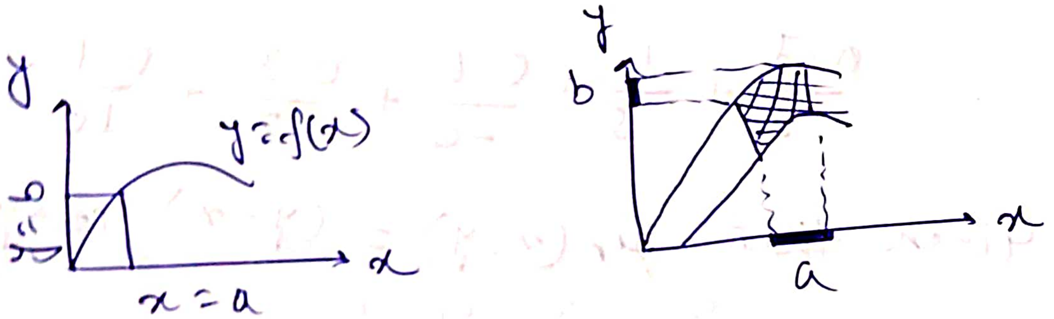
Name : Om Shree

Roll no : 2006077

Activity - 02

Ans1) The compositional rule of inference is a generalization of following familiar notion.

Suppose that we have a curve $y = f(x)$ that regulates the relation between 'x' and 'y'. When we are given $x = a$ then from $y = f(x)$, we can say that y is $f(a)$.



Let, μ_A, $\mu_C(A)$, μ_B and μ_f be the MFs for A, C(A), B and f where $\mu_C(A)$ is related to μ_A through

$$(x, y) \mu_C(A) = \mu_A(x)$$

Then, $\mu_{C(A) \cap F}(x, y) = \min[\mu_{C(A)}(x, y), \mu_F(x, y)]$

$= \min[\mu_A(x), \mu_F(x, y)]$

By projecting $C(A) \cap F$ onto y-axis, we have

$$\mu_B(y) = \max \min [\mu_c(x), \mu_f(x,y)]$$

$$= V_x [\mu_A(x) \wedge \mu_f(x,y)]$$

$$\therefore \boxed{B = A \cdot F}$$

Ans 2) $B = \frac{0.2}{-2} + \frac{0.4}{-5} + \frac{0.6}{-6} + \frac{1}{5} + \frac{0.7}{-2}$

$+ \frac{0.3}{3} + \frac{0.1}{10}$

$\Rightarrow B = \frac{0.2 \vee 0.7}{-2} + \frac{1 \vee 0.4}{-5} + \frac{0.6}{-6} + \frac{0.3}{3} + \frac{0.1}{10}$

$= \frac{0.7}{-2} + \frac{1}{-5} + \frac{0.6}{-6} + \frac{0.3}{3} + \frac{0.1}{10}$

Ans 3) Given that $\mu_R(x,y) = (y-x)/(x+y+3)$

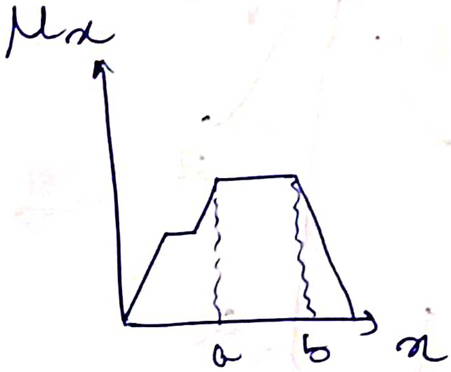
$$\Rightarrow R = \begin{array}{c|ccccc} & 2 & 3 & 4 & 5 & 6 \\ \hline 2 & 0 & 0.125 & 0.222 & 0.3 & 0.363 \\ 3 & 0 & 0 & 0.1 & 0.101 & 0.25 \\ 4 & 0 & 0 & 0 & 0.803 & 0.153 \end{array}$$

Ans 4) (i) Center of largest area (COA):

$$x^+ = \frac{\int \mu_{cm}(x) \cdot x' dc}{\int \mu_{cm}(x)\, dx}$$

(ii) Mean of maxima :-

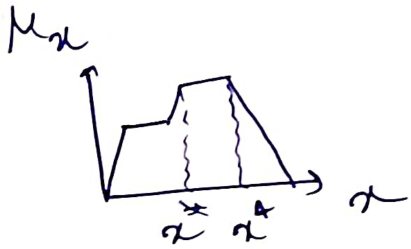
$$x^* = \frac{a+b}{2} = \frac{\sum x_{i \in m} (x_i)}{|m|}$$



where $m = \{x_i \mid \mu(x_i) = h(c)\}$

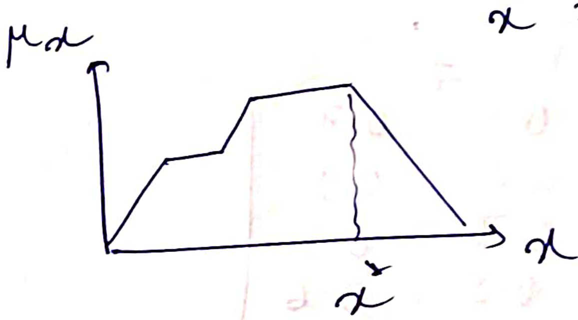
(iii) First of maxima :-

$$x^* = \min\{x \mid c(x) = \min_w c\{w\}\}$$



(iv) Last of maxima :-

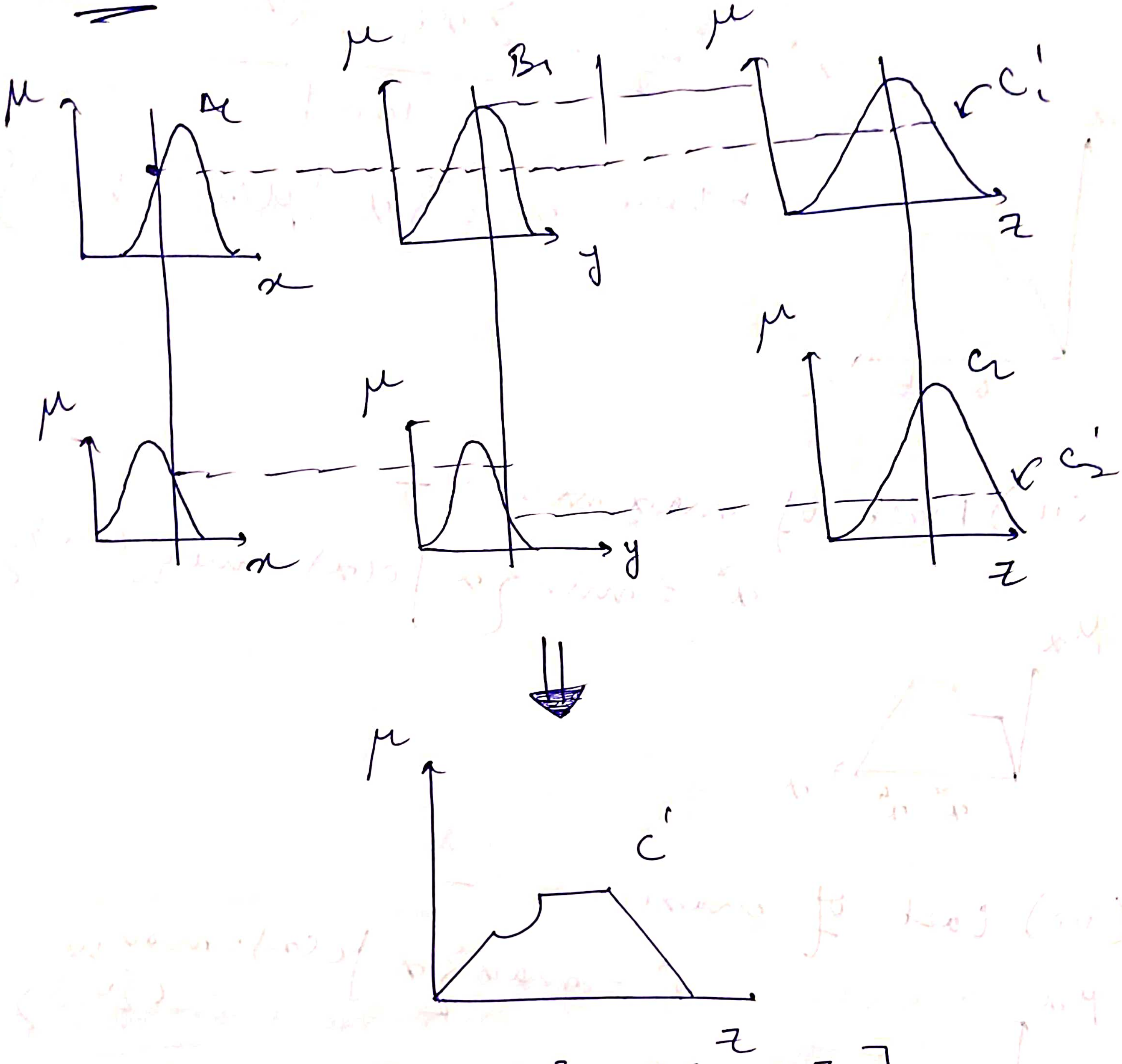
$$x^* = \max\{x \mid c(x) = \max_w c\{w\}\}$$



(v) Center of gravity :-

$$x^* = \frac{\int x \cdot \mu_c(x)\, dx}{\int \mu_c(w)\, dx}$$

Ans 5)



Ans 6)

$$R_1 = \begin{bmatrix} 0.1 & 0.3 & 0.5 & 0.7 \\ 0.4 & 0.2 & 0.8 & 0.9 \\ 0.6 & 1.0 & 0.7 & 0.3 \\ 0.8 & 0.4 & 0.5 & 0.6 \end{bmatrix}$$

$$R_x = [\max(0.1, 0.3, 0.5, 0.7), \max(0.4, 0.2, 0.8, 0.9), \max(0.6, 1, 0.7, 0.3), \max(0.8, 0.4, 0.5, 0.6)]$$

$$R_x = [0.7, 0.9, 1, 0.8]$$

$R_y = [0.8, 1, 0.8, 0.9]$ same procedure

Ans 7)

$$R1 = \begin{bmatrix} 0.1 & 0.3 & 0.5 & 0.7 \\ 0.4 & 0.2 & 0.8 & 0.9 \\ 0.6 & 0.8 & 0.3 & 0.2 \end{bmatrix} \quad R2 = \begin{bmatrix} 0.9 & 0.1 \\ 0.2 & 0.3 \\ 0.5 & 0.6 \\ 0.7 & 0.2 \end{bmatrix}$$

$$R3 = R1 \cdot R2 = \begin{bmatrix} 0.7 & 0.5 \\ 0.7 & 0.9 \\ 0.6 & 0.3 \end{bmatrix}$$

Ans 8)

$$R1 = \begin{bmatrix} 0.6 & 0.5 & 0.3 \\ 0.5 & 0.6 & 0.7 \end{bmatrix}$$

$$R2 = \begin{bmatrix} 0.7 & 0.2 & 0.4 \\ 0.1 & 0.6 & 0.6 \\ 0.4 & 1 & 0.5 \end{bmatrix}$$

$$R3 = R1 \cdot R2 = \begin{bmatrix} 0.6 & 0.5 & 0.5 \\ 0.5 & 0.7 & 0.6 \end{bmatrix}$$

Ans 9) GMP with multiple rules with multiple antecedent as:-

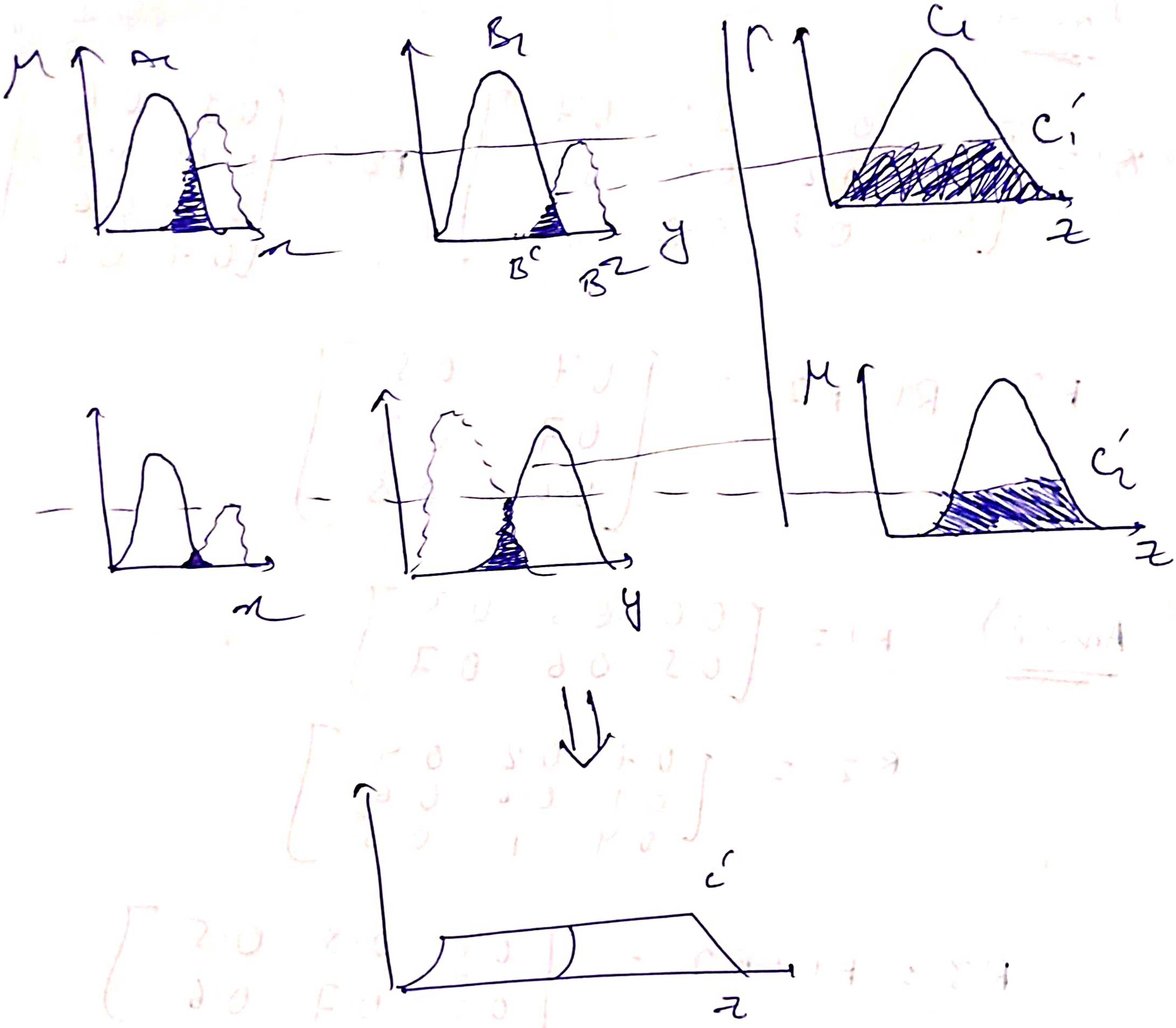
Premise 1 (fact) : x is A' and y is B

Premise 2 (rules 1) : if x is A_1 and y is B_1 then z is C_1

Premise 3 (rules 2) : if x is A_2 and y is B_2 then z is C_2

---

conclusion : z is C'



<u>Ans 10)</u> Components of Fuzzy inference system :—

<u>Rules</u> : Contains if-then rules which are provided by experts or extracted from numerical data.

<u>Inference</u> : It is responsible for mapping of fuzzy sets into fuzzy sets.

Fuzzification : Activates the linguistic variables and converts the crisp input into sets of fuzzy variables.

Defuzzification : converts fuzzy set into crisp set.

Ans 11) A linguistic variable is characterised by a quintuple (x, $T(x)$, X, g, M) in which x is the name of variable. $T(x)$ is the term set of x; X is universe of discourse, G is the syntactic rule. M is semantic rule which associates each variable to its meaning. Let, A be a linguistic value characterised by a fuzzy set with MF $\mu_A(\cdot)$. Then A^k is interpreted as a modified version of original linguistic value expressed as :—

$$A^k = \int_x [\mu_A(x)]^k / x$$

- Operation of concentration :—

$$CON(A) = A^2$$

and dilation $DIL(A) = \sqrt{A}$

INT(A) is defined by :—

$$INT(A) = \begin{cases} 2 \cdot A^2 & \text{for } 0 \leq \mu_A(x) \leq 0.5 \\ \neg 2(\neg A)^2 & \text{for } 0.5 \leq \mu_A(x) \leq 1 \end{cases}$$