

Note: Be specific and to the point in your answers. Make assumptions wherever necessary and quote it. All questions are compulsory.

- Q1. [5 marks] Consider a set $P=\{p1,p2,p3,p4\}$ of four varieties of paddy plants, set $D=\{d1,d2,d3,d4\}$ of the various diseases affecting the plants. In addition to these, also consider another set $S=\{s1,s2,s3,s4\}$ be the common symptoms of the diseases. Let R be a fuzzy relation on $P \times D$ and S be a fuzzy relation on $D \times S$. Obtain the association of the plants with different symptoms of the diseases using max-min composition

R	d1	d2	d3	d4
p1	0.6	0.6	0.9	0.8
p2	0.1	0.2	0.9	0.8
p3	0.9	0.8	0.4	0.8
p4	0.9	0.8	0.1	0.2

Matrix R

S	s1	s2	s3	s4
d1	0.1	0.2	0.7	0.9
d2	1	1	0.4	0.6
d3	0	0	0.5	0.9
d4	0.9	1	0.8	0.2

Matrix S

- Q2. [3+2 marks] In context of the following two fuzzy sets:

$$A=\{(a,0.4), (b,0.3), (c,0.1), (d,0.1), (e,0.9), (f,0.8)\}$$

$$B=\{(a,0.99), (b,0.8), (c,0.1), (d,0.2), (e,0.5), (f,0.5)\}$$

- a. Perform the following operations

- Cartesian product.
- Bounded sum.
- Bounded difference.

- b. Verify Demorgan's Law

- Q3. [4 marks] List the various properties of fuzzy sets and crisp sets. Also explain the following relation with an example: $\overline{R(x,y)} = 1 - R(x,y)$.

- Q4. [2 marks] Define learning. Differentiate between supervised and unsupervised learning.

- Q5. [2 marks] List and explain the commonly used activation functions.

- Q6. [2 marks] Explain 2D membership functions with an example.