Activity-2

1) What is compositional rule of inference? Derive the expression B= A o F where A, B and F are having their usual meanings.
2) Define the Extension Principle. Apply this principle to the given fuzzy set A in space X to obtain its image as a Fuzzy Set B in space Y using the extension principle given the mapping function as:
   $y=f(x)=x^2+2x-5$ where $x \in X$ and $y \in Y$
   A=0.2/-3 + 0.4/-2 +0.6/-1 +1/0 +0.7/1 +0.3/2 +0.1/3
3) The MF of the fuzzy relation R= "x is much smaller than y" is defined as follows:
   $\mu R(x,y)= (y-x)/(x+y+3)$, if $x<y$ and =0 if $x>=y$
   where $x \in X$ and $y \in Y$. If X={2,3,4} and Y={2,3,4,5,6} then express the fuzzy relation matrix.
4) Explain five de-fuzzification strategies which can be used in Mamdani Fuzzy Model. Which of these according to you is the most preferable strategy? Justify.
   Explain diagrammatically fuzzy reasoning for 3 rules with 2 antecedents.
5) Develop a Mamdani fuzzy inference system diagrammatically with 2-rules 2-antecedents using min and max for T-norm and T-conorm operators respectively. Show the aggregated fuzzy output if the Bell and/or Gaussian MFs are considered for antecedents and consequents.
6) Obtain projections Rx and Ry if the binary fuzzy relation R on X × Y is expressed as follows:
   R1=

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

7) Let R1="x is relevant to y" and R2= "y is relevant to z" be two fuzzy relations defined on X × Y and Y × Z respectively where X={1,2,3}, y={$\alpha, \beta, \gamma, \delta$} and Z={a,b}. R1 and R2 are expressed as following relation matrices.
   R1=

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

   R2=

$$\begin{bmatrix} 0.9 & 0.1 \\ 0.2 & 0.3 \\ 0.5 & 0.6 \\ 0.7 & 0.2 \end{bmatrix}$$

Express fuzzy relation R3=(R1 o R2)=”x is relevant to z” defined on X × Z using max-min composition.

8) Let R1=”x is relevant to y” and R2= “y is relevant to z” be two fuzzy relations defined on X × Y and Y × Z respectively where X={x1,x2}, y={y1,y2,y3} and Z={z1,z2,z3}. R1 and R2 are expressed as following relation matrices.

R1=

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

R2=

$$\begin{bmatrix} 0.7 & 0.2 & 0.4 \\ 0.1 & 0.6 & 0.6 \\ 0.4 & 1.0 & 0.5 \end{bmatrix}$$

Express fuzzy relation R3=(R1 o R2)=”x is relevant to z” defined on X × Z using max-min composition.

9) Explain Generalized Modus Ponens(GMP). Why is this also called Fuzzy reasoning or approximate reasoning? Draw the graphic interpretation of GMP using Mamdani’s fuzzy implication and the max-min composition for following case:
“Multiple Rules with Multiple Antecedents”.

10) Discuss various components of Fuzzy Inference system and explain with example.

11) Define linguistic variable as a quintuple and its associated terminologies along with a suitable example. Define Following operations for the fuzzy set A:
    i) CON(A)
    ii) DIL(A)
    iii) INT(A)
    iv) DIM(A)

    Prove that DIM(INT(A))=A