EXPERIMENT NO. 4

AIM: To implement Fuzzy Controllers. To implement Max-Min composition of two matrices obtain from Cartesian Product, which is widely used in the design of a Fuzzy Controller.

PROGRAM:

```java
import java.util.Scanner;


class Fuzzyset_rel
{
Scanner sc=new Scanner(System.in);
float[] min(float i_m, float j_m[], int len_j_m)
{
float A[] =new float[10];
for(int i=0;i<len_j_m;i++)
{
A[i]=(i_m>j_m[i])?j_m[i]:i_m;
}
return A;
}
float[][] cart(float A_m[], float B_m[], int len_A, int len_B)
{
float Ans[][]=new float[10][];
for(int i=0;i<len_A;i++)
{
Ans[i]=min(A_m[i],B_m,len_B);
}
return Ans;
}
float[][] min_max_compo(float[][] A,float[][] B, int Ar, int Ac, int Br, int Bc)
{
float[][] Ans=new float[10][10];
for(int i=0;i<Ar;i++)
```

```java
{
for(int j=0;j<Bc;j++)
{
float max=0.0f,min=0.0f;
for(int k=0;k<Br;k++)
{
min=(A[i][k]>B[k][j])?B[k][j]:A[i][k];
max=(max>min)?max:min;
}
Ans[i][j]=max;
}
}
return Ans;
}
void cart_print(float A[][],int r,int c)
{
for(int i=0;i<r;i++)
{
for(int j=0;j<c;j++)
{
System.out.format("%.2f ",A[i][j]);
}
System.out.println();
}
}
float[] scan_set(int len)
{
float S[]=new float[10];
for(int i=0;i<len;i++)
{
S[i]=sc.nextFloat();
```

```java
}
return S;
}
void Fuzzyset_print(float E[],float m[],int len)
{
System.out.format("{%.2f/%.2f",m[0],E[0]);
for(int i=1;i<len;i++)
{
System.out.format("+%.2f/%.2f",m[i],E[i]);
}
System.out.println("}");
}
}
class Fuzzyset_cart_maxmin
{
public static void main(String args[])
{
Scanner sc=new Scanner(System.in);
Fuzzyset_rel FZ=new Fuzzyset_rel();
System.out.print("Enter the no. of elements(max 10) of Rse fuzzy set Rse: ");
int len_Rse=sc.nextInt();

System.out.print("Enter the elements of Fuzzy set Rse: ");
float Rse_E[]=FZ.scan_set(len_Rse);

System.out.print("Enter the membership value of elements Fuzzy set Rse: ");
float Rse_m[]=FZ.scan_set(len_Rse);

System.out.print("Enter the no. of elements (max 10) of Ia fuzzy set Ia: ");
int len_Ia=sc.nextInt();
```

```java
System.out.print("Enter the elements of Fuzzy set Ia: ");

float Ia_E[]=FZ.scan_set(len_Ia);


System.out.print("Enter the membership value of elements Fuzzy set Ia: ");

float Ia_m[]=FZ.scan_set(len_Ia);


System.out.print("Enter the no. of elements(max 10) of N fuzzy set N: ");

int len_N=sc.nextInt();


System.out.print("Enter the elements of Fuzzy set N: ");

float N_E[]=FZ.scan_set(len_N);


System.out.print("Enter the membership value of elements Fuzzy set N: ");

float N_m[]=FZ.scan_set(len_N);


System.out.print("\nFuzzy Set Rse: ");

FZ.Fuzzyset_print(Rse_E,Rse_m,len_Rse);


System.out.print("Fuzzy Set Ia: ");

FZ.Fuzzyset_print(Ia_E,Ia_m,len_Ia);


System.out.print("Fuzzy Set N: ");

FZ.Fuzzyset_print(N_E,N_m,len_N);


System.out.print("\nCartesian Product of Fuzzy Sets Rse and Ia: \nRse X Ia: \n");

float Rse_x_Ia[][]=FZ.cart(Rse_m,Ia_m,len_Rse,len_Ia);

FZ.cart_print(Rse_x_Ia,len_Rse,len_Ia);


System.out.print("Cartesian Product of Fuzzy Sets Ia and N: \nIa X N: \n");

float Ia_x_N[][]=FZ.cart(Ia_m,N_m,len_Ia,len_N);
```

FZ.cart_print(Ia_x_N,len_Ia,len_N);

System.out.println("\nMin-Max Composition of cartesian products(Rse X Ia) & (Ia X N): \nT=(Rse X Ia) o (Ia X N)");

FZ.cart_print(FZ.min_max_compo(Rse_x_Ia,Ia_x_N,len_Rse,len_Ia,len_Ia,len_N),len_Rse,len_N);

}

}

OUTPUT:

```
ce306-pc15@ce306pc15-Vostro-3902:~$ gedit Fuzzyset_cart_maxmin.java
ce306-pc15@ce306pc15-Vostro-3902:~$ javac Fuzzyset_cart_maxmin.java
ce306-pc15@ce306pc15-Vostro-3902:~$ java Fuzzyset_cart_maxmin
Enter the no. of elements(max 10) of Rse fuzzy set Rse: 3
Enter the elements of Fuzzy set Rse: 2 4 6
Enter the membership value of elements Fuzzy set Rse: 0.3 0.7 0.9
Enter the no. of elements (max 10) of Ia fuzzy set Ia: 3
Enter the elements of Fuzzy set Ia: 2 4 6
Enter the membership value of elements Fuzzy set Ia: 0.5 0.6 0.1
Enter the no. of elements(max 10) of N fuzzy set N: 3
Enter the elements of Fuzzy set N: 2 4 6
Enter the membership value of elements Fuzzy set N: 0.4 0.5 0.6

Fuzzy Set Rse: {0.30/2.00+0.70/4.00+0.90/6.00}
Fuzzy Set Ia: {0.50/2.00+0.60/4.00+0.10/6.00}
Fuzzy Set N: {0.40/2.00+0.50/4.00+0.60/6.00}

Cartesian Product of Fuzzy Sets Rse and Ia:
Rse X Ia:
0.30 0.30 0.10
0.50 0.60 0.10
0.50 0.60 0.10
Cartesian Product of Fuzzy Sets Ia and N:
Ia X N:
0.40 0.50 0.50
0.40 0.50 0.60
0.10 0.10 0.10

Min-Max Composition of cartesian products(Rse X Ia) & (Ia X N):
T=(Rse X Ia) o (Ia X N)
0.30 0.30 0.30
0.40 0.50 0.60
0.40 0.50 0.60
ce306-pc15@ce306pc15-Vostro-3902:~$ █
```

```
ce306-pc15@ce306pc15-Vostro-3902:~$ gedit Fuzzyset_cart_maxmin.java
ce306-pc15@ce306pc15-Vostro-3902:~$ javac Fuzzyset_cart_maxmin.java
ce306-pc15@ce306pc15-Vostro-3902:~$ java Fuzzyset_cart_maxmin
Enter the no. of elements(max 10) of Rse fuzzy set Rse: 4
Enter the elements of Fuzzy set Rse: 30 60 100 120
Enter the membership value of elements Fuzzy set Rse: 0.4 0.6 1.0 0.1
Enter the no. of elements (max 10) of Ia fuzzy set Ia: 6
Enter the elements of Fuzzy set Ia: 20 40 60 80 100 120
Enter the membership value of elements Fuzzy set Ia: 0.2 0.3 0.6 0.8 1.0 0.2
Enter the no. of elements(max 10) of N fuzzy set N: 4
Enter the elements of Fuzzy set N: 500 1000 1500 1800
Enter the membership value of elements Fuzzy set N: 0.35 0.67 0.97 0.25

Fuzzy Set Rse: {0.40/30.00+0.60/60.00+1.00/100.00+0.10/120.00}
Fuzzy Set Ia: {0.20/20.00+0.30/40.00+0.60/60.00+0.80/80.00+1.00/100.00+0.20/120.00}
Fuzzy Set N: {0.35/500.00+0.67/1000.00+0.97/1500.00+0.25/1800.00}

Cartesian Product of Fuzzy Sets Rse and Ia:
Rse X Ia:
0.20 0.30 0.40 0.40 0.40 0.20
0.20 0.30 0.60 0.60 0.60 0.20
0.20 0.30 0.60 0.80 1.00 0.20
0.10 0.10 0.10 0.10 0.10 0.10
Cartesian Product of Fuzzy Sets Ia and N:
Ia X N:
0.20 0.20 0.20 0.20
0.30 0.30 0.30 0.25
0.35 0.60 0.60 0.25
0.35 0.67 0.80 0.25
0.35 0.67 0.97 0.25
0.20 0.20 0.20 0.20

Min-Max Composition of cartesian products(Rse X Ia) & (Ia X N):
T=(Rse X Ia) o (Ia X N)
0.35 0.40 0.40 0.25
0.35 0.60 0.60 0.25
0.35 0.67 0.97 0.25
0.10 0.10 0.10 0.10
ce306-pc15@ce306pc15-Vostro-3902:~$ █
```

CONCLUSION: Thus the program to implement Max-Min Composition of two matrices obtained from Cartesian product of the two Fuzzy Sets is executed and verified successfully.