Assignment #3

MODEL SOLUTION

ECE449, Intelligent Systems Engineering

Fall 2019

Department of Electrical and Computer Engineering, University of Alberta

Dr. Petr Musilek

1. Classify the following as fuzzy relations or relations:

	Classification {relation, fuzzy relation}
student – grade	relation
inflation level - interest rate	fuzzy relation
phone brand – phone price	fuzzy relation
apple color – apple ripeness	fuzzy relation
salary – age	fuzzy relation
programming language – programming effort	fuzzy relation
husband – wife	relation
season – temperature	fuzzy relation

Show another example of each (1 relation and 1 fuzzy relation).

Relation: person – name
Fuzzy relation: person – height

2. Let

$$R = \begin{bmatrix} 0.5 & 0.3 & 0.2 \\ 0.8 & 0.7 & 0.3 \end{bmatrix} S = \begin{bmatrix} 0.4 & 0.7 \\ 0.7 & 0.8 \\ 0.5 & 0.2 \end{bmatrix}$$

be matrix representations of binary fuzzy relations. Calculate the following max-min compositions: $R \circ S, \bar{R} \circ \bar{S}, S^T \circ R^T$

$$R \circ S = \sup_{y \in Y}[R(x,y)tS(y,z)] = \max_{y \in Y}[min(R(x,y), S(y,z))]$$

$$= \begin{bmatrix} \max(\min(0.5,0.4), \min(0.3,0.7), \min(0.2,0.5)) & \max(\min(0.5,0.7), \min(0.3,0.8), \min(0.2,0.2)) \\ \max(\min(0.8,0.4), \min(0.7,0.7), \min(0.3,0.5)) & \max(\min(0.8,0.7), \min(0.7,0.8), \min(0.3,0.2)) \end{bmatrix}$$

$$= \begin{bmatrix} \max(0.4,0.3,0.2) & \max(0.5,0.3,0.2) \\ \max(0.4,0.7,0.3) & \max(0.7,0.7,0.2) \end{bmatrix} = \begin{bmatrix} 0.4 & 0.5 \\ 0.7 & 0.7 \end{bmatrix}$$

$$\bar{R} \circ \bar{S} = (1 - R(x,y)) \circ (1 - S(y,z))$$

$$\bar{R} = \begin{bmatrix} 1-0.5 & 1-0.3 & 1-0.2 \\ 1-0.8 & 1-0.7 & 1-0.3 \end{bmatrix} \bar{S} = \begin{bmatrix} 1-0.4 & 1-0.7 \\ 1-0.7 & 1-0.8 \\ 1-0.5 & 1-0.2 \end{bmatrix}$$

$$\bar{R} \circ \bar{S} = \begin{bmatrix} \max(0.5,0.3,0.5) & \max(0.3,0.2,0.8) \\ \max(0.2,0.3,0.5) & \max(0.2,0.2,0.7) \end{bmatrix} = \begin{bmatrix} 0.5 & 0.8 \\ 0.5 & 0.7 \end{bmatrix}$$

$$S^T \circ R^T = \begin{bmatrix} 0.4 & 0.7 & 0.5 \\ 0.7 & 0.8 & 0.2 \end{bmatrix} \begin{bmatrix} 0.5 & 0.8 \\ 0.3 & 0.7 \\ 0.2 & 0.3 \end{bmatrix} = \begin{bmatrix} \max(0.4,0.3,0.2) & \max(0.4,0.7,0.3) \\ \max(0.5,0.3,0.2) & \max(0.7,0.3,0.2) \end{bmatrix} = \begin{bmatrix} 0.4 & 0.7 \\ 0.5 & 0.7 \end{bmatrix}$$